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SOMATIC COMPLICATIONS
FOLLOWING
LEGAL ABORTION

BY

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Translated by Stanley H. Vernon

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Jan Lindahl

INTRODUCTION

Reports in the literature differ widely with regard to the incidence and nature of the somatic disturbances that may follow legal abortions performed by the methods that were commonly employed in Sweden in the early nineteen-fifties. This applies in particular to disturbances of long duration, the occurrence of which does not appear to have been previously investigated in detail in a major series. For this reason the Swedish Medical Research Council, which has initiated research on several aspects of the abortion problem, arranged an investigation designed to elucidate the incidence and character of the somatic disturbances which had followed legal abortions in a Swedish series. The results of this investigation will be reported in the following. Attention will chiefly be given to those disturbances that were observed a relatively long time, usually at least one year, after the operations.



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EARLIER INVESTIGATIONS INTO LATE COMPLICATIONS FOLLOWING LEGAL ABORTION

Relatively few detailed investigations have been communicated with respect to the incidence and character of the disturbances which, in large series, have been attributed to operations for the interruption of pregnancy, and sometimes sterilization, performed some considerable time before the follow up by methods corresponding to those used in the present series. On the other hand, there are quite a number of reports on minor groups of cases with some particular change that has been ascribed to the legal abortions. These data have not, however, enabled any reliable idea to be gained of the frequency with which such changes actually do result from the operations.

Walthard & Burkhard (1932) observed no disturbances of menstruation in approximately 550 patients who had undergone dilatation of the cervix and evacuation of the uterine contents (hereinafter called curettage) or abdominal hysterotomy and, in most cases, sterilization. Following the latter operation, however, endometriosis occurred in the abdominal wall in about 10 per cent of the cases.

Kühnel (1933) followed up 72 patients who had been subjected to dilatation of the cervix and curettage or vaginal hysterotomy. He found that 75 per cent were asymptomatic, but fairly pronounced symptoms referable to the genital organs had occurred in a few cases. In 2.8 per cent salpingitis had developed before the follow up.

Mayer (1933) communicated observations from Russia after interruption of pregnancy in a large number of cases. The results

reported were based on several different series that varied considerably in regard to the types of operations. These latter had usually consisted of dilatation of the cervix and curettage, but several different methods had been employed for the former procedure. In other cases vaginal hysterotomy had been done. The observed disturbances that were attributed to the operations showed great variability and in many series were quite numerous. Lesions of the endometrium and myometrium were common; also cicatrization, stenosis, impaired regeneration of the endometrium, atrophic changes in the genital organs, disturbances of menstruation, dysmenorrhea, and an increased tendency to spontaneous abortion. Perforations of the uterus were reported in up to 0.5 per cent of the cases, and gave rise to peritoneal involvement with adhesions and intestinal obstruction. Inflammatory conditions were observed in the adnexa, as well as a substantially increased incidence of extrauterine pregnancies. Endocrine disorders, cystic degeneration of the ovaries, and such disturbances as oligomenorrhea or amenorrhea were frequent, the last-named condition occurring in up to 10 per cent of the cases in some series; while disturbances of the ovulatory process were reported in up to 90 per cent of the patients in one series. Late complications consisting of infections, menometrorrhagia and amenorrhea were found in at least 3.5 per cent in some series. Women who had undergone three or four interruptions of pregnancy were as a rule sterile. The incidence of sterility due to the operations varied between 0.9 and 5.4 per cent. This condition was often extremely resistant to therapy. A greatly increased incidence of complications associated with subsequent deliveries was also recorded. In particular, the Russian authors found a higher incidence of stillbirths, uterine inertia, placenta praevia, disturbances during the placental stage, delayed involution, postpartum infections, and a greater frequency of operative measures at childbirth.

Feniger & Wetterdal (1947) followed up 183 patients, most of whom had undergone various types of dilatation of the cervix and curettage, vaginal hysterotomy or abdominal hysterotomy and sterilization. Amenorrhea had occurred in one case, disturbances such as oligomenorrhea, menorrhagia and dysmenorrhea each in between 4 and 8 per cent; and 5.6 of the patients had been

involuntarily sterile. There was no increased incidence of extra-uterine pregnancies or complicated deliveries.

Lork (1948) observed oligomenorrhea or amenorrhea in 21 cases, adnexitis in 14 of 113 patients who had been submitted to varying types of dilatation of the cervix and curettage, or abdominal or vaginal hysterotomy.

Svanberg (1949), in a similar series of 211 cases, found disturbances of menstruation in 11.9 per cent, though 3.4 per cent were improved in this respect by comparison with their preoperative states. Sterility had been present in 5.1 per cent of the cases. Probably the incidence of premature deliveries, and possibly that of placental stage operations too, had risen as a result of the operations.

Fiehn (1950) followed up 72 patients, the majority of whom had undergone dilatation of the cervix and curettage or vaginal hysterotomy. She found mild inflammatory conditions involving the genital organs in a number of cases, but no serious complications on clinical examination; a few patients were submitted to hysterosalpingography. It was possible, she reported, that sterility had arisen in not a few cases.

Holtz (1950) communicated a series of 462 patients in whom dilatation of the cervix and curettage or vaginal hysterotomy had been performed 1—4 years earlier. Somewhat over 25 per cent of the cases were subjected to clinical examination. In 12.8 per cent there were symptoms referable to the genital organs. Painful conditions had arisen in 0.4 per cent. Dysmenorrhea, hypomenorrhea or oligomenorrhea were occasionally found. Disturbances of menstruation had occurred in a total of 8 per cent, but 2.6 per cent had been freed from earlier disturbances of that nature. The incidence of metrorrhagia was stated to be 0.9 per cent. Inflammatory conditions involving the adnexa were observed in 1.7 per cent; sterility in less than 6 per cent of the cases. No appreciable abnormalities were observed in the course of subsequent pregnancies and deliveries. In the opinion of Holtz, postoperative complications were rare and the incidence of the observed disturbances was not substantially higher than that among women in general. The methods employed were accordingly felt to involve minimum risks of somatic disturbances.

Kolonja & Ulm (1952) investigated a similar series. Of 123 patients, five showed endometriosis of the anterior part of the cervix; otherwise nothing of note was observed at the clinical examination. Somewhat over 1 per cent of the patients had been involuntarily sterile. There was no demonstrably increased incidence of complicated deliveries, spontaneous abortions or extra-uterine pregnancies.

Asherman (1953) reported a high incidence of sterility. However, his series differed in important respects from the others referred to here and hence is not comparable with them.

Engel (1953) followed up more than 200 patients, most of whom had undergone pronounced dilatation of the cervix and curettage. The immediate postoperative complications were relatively few, about 93 per cent of the patients being discharged as healthy. The complications observed at follow-up examinations were about seven times as numerous and affected 65 per cent of the cases. Menstrual disturbances and sequelae of infections were recorded in 10 and 15 per cent, respectively, of the cases; sterility in at least 27.7 per cent.

Alex (1958) followed up 142 cases, about 50 per cent of which had been subjected to dilatation of the cervix and curettage, and about 25 per cent to vaginal hysterotomy. Two patients had been involuntarily sterile but almost 50 per cent had subsequently borne children. No increased incidence of complicated deliveries was detectable. The extent to which the legal abortions had caused disturbances in the genital organs could not be ascertained.

Kolstad (1958) found various types of symptoms referable to the genital organs in 13.6 per cent of 139 patients, most of whom had undergone dilatation of the cervix and curettage or abdominal hysterotomy. Involuntary sterility had occurred in 3.4 per cent. Thirty per cent of the patients had subsequent pregnancies.

In most of the earlier follow-up investigations relating to the operations in question, the operative methods in cases with subsequent disturbances have not been reported. In several instances the results appear to have been based on data furnished by the patients, and only to a minor extent on clinical examinations. In numerous

papers it is not clear whether observed disturbances have been definitely attributed to the interruptions of pregnancy or not. Hysterosalpingography and endometrial biopsy seem to have been carried out only in a very limited number of cases. There have frequently been major variations between the reports of different examiners regarding the incidence and nature of disturbances attributed to the operations.

PERSONAL INVESTIGATION

I. Material and Methods

The aim of this investigation was to study the operative and postoperative course and the somatic sequelae of 1,044 legal abortions without and 144 with sterilization. These 1,188 operations had been performed at six departments of obstetrics and gynecology in Stockholm during the period from 1 April 1952 to 3 May 1953 on women residing in that city. The operations were carried out in accordance with the provisions of the relevant Swedish laws: *vide Svensk Författningssamling* 1938, No. 318, Act Relating to the Interruption of Pregnancy, Stockholm 1938; *Svensk Författningssamling* 1941, No. 282, Act Relating to Sterilization, Stockholm 1941; *Svensk Författningssamling* 1946, No. 210, Amendments to the Act Relating to the Interruption of Pregnancy, Stockholm 1946.

The procedure in this investigation was to be as follows:

1. On the basis of case records, complications directly following the operations would be studied.
2. Three weeks after operation the patients would be subjected to clinical examination by gynecologists from the hospitals where the operations had been performed.
3. About one year after operation the patients would be followed up by the present author.

The purpose was accordingly to elucidate the incidence and type of complications directly associated with the operations, of disturbances occurring relatively soon thereafter, and, lastly, of the per-

sistent disturbances that might be observed relatively long after the operations.

For various reasons, examinations three weeks or more post-operatively were impracticable in some cases. When the projected follow-up investigation was embarked upon, about one year after the operations, many patients had moved from Stockholm; a few had died; a number could not be asked to attend for examination for reasons of discretion, e. g., cases of marital infidelity and patients whose families were not aware of the operations. A number of patients were not contacted because their mental condition at the time of the operation had been such that it was felt inadvisable to bring the whole matter up again. A further number refused any form of contact or declined to undergo clinical examination. Three weeks after the operations it was possible to examine 1,133 patients, but later on, about one year or more postoperatively, only 1,013 of the original 1,188 were available for follow-up investigation by the author. Hereinafter, these 1,013 cases are referred to as "followed-up". An additional 48 patients, however, furnished some information on their conditions following the operations. Lastly, probably incomplete data were secured with regard to subsequent pregnancies in some of the remaining cases in the series. These two last-named groups of patients are included in the non-followed-up cases in the sequel.

Indications for and Types of Operation, Number and Course of Earlier Pregnancies, and Genitourinary Tract Disturbances Before or at the Time of the Operation

In tables 1—5 the series is classified in various respects.

A number of patients had had disturbances in the genitourinary organs, or symptoms referable thereto, before the interruption of pregnancy. Salpingitis had thus been present in 85 cases, including 75 that had undergone legal abortion alone. Sixty-nine of these patients were in the followed-up group. One patient had undergone an operation for extrauterine pregnancy during the course of the interrupted pregnancy; she thus had a twin pregnancy. At the operation in question pathologic changes were observed in both

Table 1. *Types of operation and indications.*

Type of operation	Indication						Total
	Mental disease	Somatic disease	Weakness	Foreseen weakness	Eugenic indication	Humanitarian indication	
Legal abortion ..	271	67	533	153	18	2	1,044
Legal abortion and sterilization	32	17	82	4	9	—	144

Table 2. *Total of cases and followed-up cases tabulated with reference to indications for the operations.*

Indication for operation	Total of cases	Followed-up cases
Mental disease	303	240
Somatic disease	84	68
Weakness	615	548
Foreseen weakness	157	138
Eugenic indication	27	17
Humanitarian indication	2	2
Total	1,188	1,013

Table 3. *Total of cases and followed-up cases tabulated with reference to age at the time of operation and to the type of operation.*

Age	Legal abortion		Legal abortion and sterilization	
	Total of cases	Followed-up cases	Total of cases	Followed-up cases
≤ 20 years	73	57	—	—
> 20 ≤ 30 years	494	410	13	12
> 30 ≤ 40 years	401	347	107	98
> 40 years	76	67	24	22
Total	1,044	881	144	132

Table 4. *Total of cases and followed-up cases tabulated with reference to the number of previous pregnancies and to the type of operation.*

Number of previous pregnancies	Legal abortion		Legal abortion and sterilization	
	Total of cases	Followed-up cases	Total of cases	Followed-up cases
0	232	172	3	2
1	209	168	8	8
2	229	207	29	26
3	199	179	35	34
4	94	83	31	28
5	47	42	18	18
6	24	21	7	5
7	6	5	5	4
8	3	3	4	4
≥ 9	1	1	4	3
Total	1,044	881	144	132

Table 5. *Occurrence of previous pregnancies with pathologic course in the total series and in followed-up cases.*

	Total of cases	Followed-up cases
One premature delivery	29	29
Two premature deliveries	4	4
Threatened abortion or premature delivery	4	4
One spontaneous abortion	141	125
Two spontaneous abortions	32	28
Three spontaneous abortions	8	8
One criminal or infected abortion	36	32
Two or more criminal or infected abortions	13	12
One extrauterine pregnancy	8	7
One legal abortion	164	146
Two legal abortions	17	16
Three legal abortions	1	1

fallopian tubes, one of which was excised and the other resected. During the earlier course of the interrupted pregnancy, eight patients had had uterine hemorrhages; in one of them after repeated attempts at criminal abortion. Six had suffered from gonorrheal

infection, and two from salpingitis before the pregnancy was terminated. Of the latter two, one had been subjected to exploratory laparotomy for suspected appendicitis; the other had salpingitis at the time of legal abortion.

Three patients showed hemorrhage from the uterus when the operation was performed. In one of them the cervical canal was a fingerbreadth in diameter; in another whose cervix was closed, incomplete abortion was found at operation; but in the third case the pregnancy appeared to be otherwise normal.

Twenty-three patients had pronounced fluor vaginalis, colpitis or cervical erosion at the time of operation. Ten had urinary tract infections either then or during the earlier course of pregnancy.

Two patients with hemorrhage during pregnancy, one with gonorrheal infection, one with urinary tract infection and six with fluor vaginalis, colpitis or cervical erosion were not included in the followed-up cases.

From table 5 it is evident that a number of patients had earlier undergone legal abortions. During the relevant period 1952—1953, pregnancies were terminated by the method of vaginal hysterotomy, of which more below, in 106 patients who had already undergone the same type of operation at least once. Ninety-seven of these women were included in the followed-up cases.

Management of the Patients and Operative Technique. The legal abortions were performed at the departments of obstetrics and gynecology of six different hospitals by between 35 and 40 operators, most of whom had relatively wide experience of the relevant surgical measures.

The great majority of patients were anesthetized with nitrous oxide and ether. A few, in whom the method of dilatation of the cervix and curettage was employed, received intravenous anesthesia with a barbiturate (Narkotal, Astra). Local anesthesia was given in 114 patients who underwent vaginal hysterotomy, about 40 cc of 0.5 per cent xylocaine solution being administered. Very occasionally, supplementary nitrous oxide and ether anesthesia was required.

The operative methods were as follows:

Dilatation of the cervix and curettage. Here Hegar dilators were used. In some cases the dilatation corresponded to Hegar 10; in others it was more pronounced, though not higher than Hegar 17. The uterine contents were evacuated by means of ovum forceps, blunt scoop and blunt curette.

Vaginal hysterotomy and excochleation of the ovum. The method has been described by von Friesen (1946) and Holtz (1949), among others. Following an incision in the vaginal wall on the anterior surface of the cervix — usually in a transverse curve but occasionally in the sagittal plane — the urinary bladder was freed from the above-mentioned surface and raised, chiefly with the use of blunt dissection. A longitudinal midline incision was then made in the anterior wall of the uterus, commencing in the uppermost part of the cervix and extending 4—5 cm upwards in the uterine wall. The fetus and placenta were removed digitally and instrumentally, the former often after podalic version and extraction with perforation of the head. Following curettage of the uterine cavity with a blunt scoop and blunt curette, the uterine and vaginal walls were closed with isolated catgut sutures. Prior to hysterotomy six patients were subjected to dilatation of the cervix up to Hegar 10—13.

Abdominal hysterotomy and excochleation of the ovum. This operation was performed in four cases. In two of them the incision was made in the transitional zone between cervix and corpus, being longitudinal in one and transverse in the other. In the remaining two it was made in the anterior wall of the corpus and in the fundus, with coincident enucleation of intramural myomas. The uterus was emptied digitally and with the aid of blunt instruments. The uterine wall was closed with isolated catgut sutures, the row of which was then covered with peritoneum.

Abdominal hysterotomy, excochleation of the ovum and unilateral or bilateral resection of the tubes, or in some cases bilateral salpingectomy. — The hysterotomy was performed as described above. In 92 cases the incision was made in the upper part of the corpus — in 91 of them in one uterine cornu and the contiguous part of the fundus; in the remaining case, in the anterior wall of

the corpus. In 38 cases it was made in the isthmic region, as a transverse incision in 35 and longitudinal in three. The operative measures on the tubes included cornual resection. One patient was subjected to bilateral salpingectomy; another to unilateral resection of the tube, the contralateral tube being absent. Normal vermiform appendices were removed in six cases.

Dilatation of the cervix to Hegar 13, curettage, and bilateral resection of the tubes. The last-named measure was carried out via laparotomy directly after cervical dilatation and curettage as described above.

Vaginal hysterotomy, excochleation of the ovum, and bilateral salpingectomy or resection of one tube. The vaginal hysterotomy conformed to the procedure described above, though in one case the cervix was dilated to Hegar 10—13. The operations on the tubes were performed via laparotomy, as above, immediately after the vaginal hysterotomy. In one case it was attempted to resect the tubes per vaginam, but this failed and the sterilizing operation was performed via laparotomy; since one tube was absent, unilateral resection was done.

Dilatation of the cervix with laminaria dilators, curettage, and bilateral salpingectomy. Three to four laminaria dilators were inserted and the uterine contents evacuated in the usual way the following day. In one case, however, dilatation with Hegar dilators was required. Three or four days later, when the patients were afebrile, bilateral salpingectomy was done via laparotomy. One patient also underwent ovarian resection for a cyst.

Supravaginal hysterectomy and bilateral salpingectomy. This operation was resorted to in one patient with uterine myoma and chronic salpingitis.

For the laparotomies a transverse incision above the pubic symphysis was used in two cases and midline incisions between the umbilicus and symphysis in the others. The suture material consisted of silk or steel wire in the skin and catgut elsewhere.

During most of the operations injections were given of pituitary extract and ergotamine to stimulate uterine contractions.

The urinary bladder was catheterized in connection with the operations. In patients who were found to have gross hematuria, an indwelling catheter was retained for 4—5 days.

The patients were allowed up as from the first or second day after the operation.

During the first 3—4 days estrogenic drugs were administered in 1,104 of the 1,188 cases. Nearly 1,100 patients received 6 mg diethylstilbestrol by mouth daily; a few patients 0.2 mg ethinyl estradiol by mouth daily for 2—3 days or 50,000—100,000 I. U. estradiol monobenzoate by intramuscular injection for up to three days.

Patients without complications who had been operated on by the vaginal route were generally discharged on the fifth or sixth day, those who had undergone laparotomy, on the tenth to twelfth day after operation. A few patients were subfebrile on discharge; the remainder afebrile.

Inflammatory complications following the operations were treated with chemotherapeutic agents and antibiotics.

Operative methods, durations of pregnancy and the numbers of followed-up cases are shown in tables 6 and 7.

Table 6. *Durations of pregnancy and operative methods in cases of legal abortion, and number of followed-up cases.*

Duration of pregnancy	Dilatation H. 13 and curettage		Dilatation H. 17 and curettage		Vaginal hysterotomy		Vaginal hysterotomy and dilatation of cervix		Abdominal hysterotomy		Abdominal hysterotomy and enucleation of myoma	
	Total	Foll-owed up	Total	Foll-owed up	Total	Foll-owed up	Total	Foll-owed up	Total	Foll-owed up	Total	Foll-owed up
Up to 8 wks	1	1	—	—	—	—	—	—	—	—	—	—
9—12 wks	15	9	15	13	33	26	—	—	—	—	—	—
13—16 wks	3	3	16	13	386	338	2	2	—	—	1	1
17—20 wks	—	—	1	1	511	433	4	2	2	2	1	1
21—24 wks	—	—	—	—	52	35	—	—	—	—	—	—
25—28 wks	—	—	—	—	1	1	—	—	—	—	—	—
Total	19	13	32	27	983	833	6	4	2	2	2	2

Table 7. *Durations of pregnancy and operative methods in cases of legal abortion and sterilization, and number of followed-up cases.*

Duration of pregnancy	Dilatation of cervix and bilateral resection of tubes		Vaginal hysterotomy and bilateral salpingectomy ¹		Laminaria dilatation, curettage and bilateral salpingectomy		Abdominal hysterotomy and bilateral resection of tubes; isthmic incision ²		Abdominal hysterotomy and bilateral resection of tubes; corporeal incision		Supravaginal hysterectomy and bilateral salpingectomy	
	Total	Followed up	Total	Followed up	Total	Followed up	Total	Followed up	Total	Followed up	Total	Followed up
9—12 wks	1	1	—	—	—	—	3	2	7	7	—	—
13—16 wks	—	—	—	—	6	6	16	15	34	31	1	—
17—20 wks	—	—	5	3	1	1	17	17	49	46	—	—
21—24 wks	—	—	—	—	—	—	2	2	2	1	—	—
Total	1	1	5	3	7	7	38	36	92	85	1	—

¹ In one case, unilateral resection of tube.² In one case, unilateral resection of tube; in one, bilateral salpingectomy.

In table 8 is set forth the number of pregnancies which these patients had had prior to those that were interrupted by the method of dilatation of the cervix and curettage or vaginal hysterotomy. The number of followed-up cases is also indicated.

Table 8. *Cases of dilatation of cervix and curettage or vaginal hysterotomy, with reference to number of previous pregnancies and number of cases followed up.*

Number of previous pregnancies	Dilatation of cervix H.13 and curettage		Dilatation of cervix H.17 and curettage		Vaginal hysterotomy	
	Total	Followed up	Total	Followed up	Total	Followed up
0	7	6	5	3	220	163
1	4	2	5	5	199	160
2	3	3	4	3	221	200
3	1	1	8	6	189	171
≥ 4	4	1	10	10	160	143
Total	19	13	22	27	989	837

A total of 1,013 patients, or 85.3 per cent of the entire series of 1,188 cases, were followed up. From the description of the series it is evident that these 1,013 cases may be considered representative of the whole in those respects that have been discussed.

In 48 cases, as mentioned above, certain anamnestic data were obtained concerning the results of the operations. This group, representing 4 per cent of the total series, did not diverge appreciably from the other cases in the respects referred to above. Two of these 48 patients had undergone dilatation of the cervix and curettage; 43, vaginal hysterotomy; two, abdominal hysterotomy and bilateral resection of the tubes; and one patient supravaginal hysterectomy and bilateral salpingectomy.

II. Immediate Complications

The incidences of complications are shown in table 9.

Re-suture of uterine and vaginal walls or re-curettage was performed in patients with major hemorrhage following the operations. Most cases were subjected, however, only to re-suture of the vaginal wall. Re-curettage was performed with blunt instruments. In those who had undergone laparotomy, re-suture was for the purpose of closing ruptured abdominal wounds. Three patients underwent both re-curettage and re-suture.

In five cases profuse hemorrhage during the operation required blood transfusion or other intravenous administration of fluid; the sixth patient developed postoperative anemia that necessitated prolonged hospitalization. Five of these six patients underwent follow-up examinations 1—5 years later.

The patient with perforation of the uterus, intestinal obstruction and hematuria was subjected to laparotomy a few days after the interruption of pregnancy. An intestinal loop adherent to the site of perforation in the uterine wall was freed, the subsequent course being uneventful.

Table 9. Incidence of complications associated with different operations.

Complications	Dilatation of cervix H. 13 and curetage	Dilatation of cervix H. 17 and curetage	Vaginal hysterotomy	Vaginal hysterotomy and dilatation of cervix	Abdominal hysterotomy	Laminaria dilatation, curetage and sterilization	Other legal abortions per vaginam and sterilization via laparotomy	Legal abortions by abdominal route and sterilization
Perforation of uterus, ileus and hematuria	—	—	—	1 (1)	—	—	—	—
Re-suture	—	—	7 (1)	—	—	—	—	6 (1)
Re-curetage and, in some, re-suture	—	—	5	1	—	—	—	—
Major hemorrhage during operation ..	—	1	29 (2)	—	—	—	2 (1)	—
Endometritis	—	—	4 (1)	—	—	—	—	—
Salpingitis	1	—	5 (2)	—	—	—	—	—
Incomplete abortion	—	—	5	—	—	—	—	—
Hematoma of vagina or parametrium	—	—	3	—	—	—	—	—
Obscure postoperative abdominal pain	—	—	13	—	—	—	—	2
Thrombosis of lower leg	—	—	1	—	—	1	1 (1)	1
Hematuria	—	—	2	—	—	—	—	—
Urinary tract infection	—	—	11 (2)	—	—	—	—	—
Total cases	19	32	983	6	4	7	6	131 ¹

¹ One patient with uneventful postoperative course had undergone supravaginal hysterectomy and bilateral salpingectomy.

N.B. The first figures refer to the total number with the relevant complications; parenthesized figures the number that were not followed up 1—5 years later.

The only death directly associated with the operation occurred in the patient who had profuse hemorrhage after interruption by the vaginal route and sterilization. This woman was a 32-year-old gravida V, para IV with a pregnancy of 17—20 weeks' duration. The indication for therapeutic abortion was chronic nephritis, and the operation was performed under nitrous oxide and ether anesthesia. Vaginal hysterotomy was carried out first in the manner described earlier. Immediately thereafter an attempt was made at sterilization per vaginam, but it had to be abandoned due to technical difficulties, the operation being completed as a laparotomy. One tube could not be identified; it had probably been removed at a previous operation for ovarian cyst. The remaining left tube was resected. This patient died about 12 hours after the operation from intraperitoneal hemorrhage arising from the left parametrium.

Patients with incomplete abortions were subjected to curettage for hemorrhages shortly, but not immediately, after the operations. For this procedure sharp instruments were used.

Those with gross hematuria following operation were treated with indwelling catheters for 4—5 days, after which the course was uneventful. Urinary tract infections were mild and of short duration.

In addition to the case with perforation of the uterus, intestinal obstruction and hematuria, five patients had more than one of the complications listed in the table. Of two patients with urinary tract infection one also had endometritis, the other obscure pain in the lower abdomen. One of two patients with salpingitis had profuse hemorrhage during the operation, though it required no special measures; the other was subjected to re-curettage for hemorrhage after the interruption of pregnancy. One patient who underwent re-curettage and re-suture developed a hematoma in the vaginal wall. Each of these five patients had undergone vaginal hysterotomy.

It is evident from the foregoing that complications occurred in 80 (8.1 per cent) of the 983 patients who had been submitted to vaginal hysterotomy without dilatation of the cervix. In those with legal abortions by the abdominal route plus sterilization, the corresponding incidence was 6.9 per cent. In other groups of cases there were only occasional complications.

Perforation of the uterus, intestinal obstruction, hemorrhages requiring some measure, inflammatory conditions in the genital organs, hematoma of the vagina or parametrium, thrombosis and hematuria were regarded as serious complications. These occurred in 43 patients, or 3.6 per cent of the total of 1,188; in 36 (3.7 per cent) of the 983 who had undergone vaginal hysterotomy; in a few who had been subjected to other types of operations but not sterilization; and in four (2.8 per cent) of the 144 with interruption of pregnancy and sterilization. The last-named four included the only surgical death in the series, corresponding to a mortality of 0.7 per cent in cases with legal abortion plus sterilization.

Temperature reactions after the operation are shown in table 10. In patients who had undergone laminaria dilatation, curettage and sterilization, the figures refer to temperatures following operations on the tubes via laparotomy.

In most cases with temperatures exceeding 38°C , those temperatures persisted for only a day or so. Of the 130 cases with temperatures exceeding 38° or elevated for more than five days after vaginal hysterotomy, 108 showed otherwise uneventful post-operative courses. These 130 represented 13.2 per cent of the patients who had undergone the above-mentioned operations.

It is clear from the table that fairly pronounced temperature reactions showed a relatively even distribution with respect to the different types of legal abortions. Aside from 21 patients who had undergone vaginal hysterotomy, one who had undergone the same procedure and dilatation of the cervix, and four who had undergone both legal abortion and sterilization, all cases with post-operative temperatures exceeding 38° or elevated for over five days were followed up, usually 1—5 years later.

The occurrence of complications in relation to the number of earlier pregnancies and to the duration of pregnancies prior to interruption by vaginal hysterotomy will be seen from tables 11, 12 and 13.

In tables 11 and 12 the series consists of vaginal hysterotomies without dilatation of the cervix, though in three cases with sterilization. One of these latter three patients had profuse hemorrhage during the operation. Table 13 comprises patients who underwent

Table 10. *Postoperative temperature.*

Temperature	Dilatation of cervix H.13 and curettage	Dilatation of cervix H.17 and curettage	Vaginal hysterotomy	Vaginal hysterotomy and dilatation of cervix	Dilatation of cervix and curettage, or vaginal hysterotomy and sterilization	Laminaria dilatation, and curettage and sterilization	Abdominal hysterotomy	Abdominal hysterotomy and sterilization ¹	
								Corporal incision	Isthmic incision
Max. 37.5°; fifth day afebrile	7	8	309	1	1	—	—	2	—
Max. 38°; fifth day afebrile	10	19	544	1	2	3	1	48	16
Subfebrile 1 wk.	—	—	4	—	—	—	—	1	2
Max. 39°; fifth day afebrile	2	4	89	2	1	2	3 ²	37 ³	16
Max. 40°; fifth day afebrile	—	1	27	2	—	1	—	1	—
Max. over 38°; elevated not more than 2 wks ..	—	—	7	—	1	1	—	4	4
Elevated for more than 2 wks or on discharge	—	—	3	—	1 ¹	—	—	4	4
Total	19	32	983	6	6	7	4	93	38

¹ Patient died following operation.² In two cases, enucleation of myoma too.³ One case of supravaginal hysterectomy and bilateral salpingectomy.

Table 11. *Incidence of major hemorrhage during or hemorrhage following vaginal hysterotomy without dilatation of cervix in 1952-53, in relation to the number of previous childbirths.*

Number of child-births	Total number of cases	Major hemorrhage during operation	Re-curettage, re-suture	Incomplete abortion	Total of complications
0	252	9	1	1	11
≥ 1	734	21	11	4	36
Total	986	30	12	5	47

Table 12. *Incidence of major hemorrhage during or hemorrhage following vaginal hysterotomy without dilatation of cervix in 1952-53, in relation to the duration of pregnancy prior to interruption.*

Duration of pregnancy	Total number of cases	Major hemorrhage during operation	Re-curettage, re-suture	In-complete abortion	Total of complications
9-12 wks	33	1	—	—	1
13-16 wks	386	11	4	2	17
17-20 wks	514	16	8	3	27
21-24 wks	52	2	—	—	2
25-28 wks	1	—	—	—	—
Total	986	30	12	5	47

vaginal hysterotomy with or without dilatation of the cervix but not sterilization.

Judging from table 11, nulliparae did not present any special operative difficulties that might have been manifested in an increased number of the relevant complications. Table 12 suggests that major hemorrhage during the operation was relatively independent of the duration of the interrupted pregnancies, whereas postoperative hemorrhages requiring further surgical measures were confined to patients with pregnancies of between 13 and 20 weeks'

Table 13. *Incidence of complications, excluding hemorrhage, in relation to the duration of interrupted pregnancy in cases of vaginal hysterotomy with or without dilatation of cervix but not sterilization in 1952-53.*

Complication	Duration of pregnancy					Total
	9-12 wks	13-16 wks	17-20 wks	21-24 wks	25-28 wks	
Perforation of uterus, ileus and hematuria	—	—	1	—	—	1
Hematuria	—	1	1	—	—	2
Hematoma of vagina or parametrium	1	—	2	—	—	3
Endometritis	—	1	2	1	—	4
Salpingitis	—	4	1	—	—	5
Urinary tract infection ..	—	8	2	1	—	11
Obscure postoperative abdominal pain	—	6	7	—	—	13
Total of complications	1	20	16	2	—	39
Total of cases	33	388	515	52	1	989

duration. According to table 13 the complications listed there were not definitely correlated to the duration of pregnancy. Of the inflammatory complications tabulated, salpingitis and endometritis had each occurred in one gravida I, whereas other inflammatory complications and hematoma of the vagina or parametrium occurred in women who had had earlier pregnancies. The various complications recorded in the above tables were too few, and the series too heterogeneous (between 35 and 40 different operators), to permit any definite conclusion regarding the influence of the tabulated factors on the occurrence of postoperative complications.

None of the 30 patients who had major hemorrhage during vaginal hysterotomy (the woman who died from intraperitoneal hemorrhage has been excluded) had received local anesthesia. This form of anesthesia was employed by a few operators; but they were probably the ones with the greatest experience of such

operations. In view of this, it seemed not unlikely that the observations on major hemorrhage during the operations were dependent in some degree on the somewhat heterogeneous character of the series. As regards the influence of local anesthesia on the occurrence of such hemorrhage, no conclusions could thus be drawn from the series.

Seventy-five patients who underwent legal abortions reported a history of salpingitis. One of them was subjected to re-curettage and had salpingitis following the interruption of pregnancy. No patient with any inflammatory condition of the genitourinary organs following the legal abortion had suffered from genitourinary tract infection during pregnancy.

To judge from the above data the operations performed here did not involve any appreciable risk of a recurrence of earlier salpingitis immediately after the operations. Some reservation must be made, however, for the patients' own reports of previous salpingitis. Inflammatory conditions involving the genitourinary organs during the subsequently interrupted pregnancy apparently involved no danger of such states occurring after the operations. However, most genitourinary tract infections during that time had been treated before the operations.

Of the 994 patients who were subjected to some type of vaginal hysterotomy, 106 had previously undergone similar operations. In one of these women re-curettage was required; another had major hemorrhage during the operation; a third developed urinary tract infection postoperatively. The incidence of complications was not higher in these 106 cases than in others subjected to vaginal hysterotomy in 1952 or 1953. In one patient who had previously undergone vaginal hysterotomy an attempt to perform the same operation was unsuccessful. The operation zone anterior to the cervix was severely cicatrized and difficult to penetrate as a result of earlier surgery; the attempt had to be abandoned and pregnancy was terminated by dilatation of the cervix and curettage.

It is evident from the foregoing that previous vaginal hysterotomies had not increased the danger of complications, nor, as a rule, appreciably heightened the difficulties in performing the same operation once more.

DISCUSSION

In studying the incidence of immediate complications and their relationship to various factors, the series must be regarded as heterogeneous, the operations having been performed by many different surgeons at a number of departments. Comparison of the present series with others reported earlier, with respect to the incidence of complications, was often difficult owing to divergent views on the definition of appreciable complications. The patients who underwent dilatation of the cervix and curettage numbered only fifty-one. Hence it could not be decided if they differed essentially, with regard to incidence of complications, from groups of cases subjected to similar operations and described by Kallinikoff (1928), Spitzer (1933), Jerlow (1943), Kuder & Finn (1945), Brosset (1946), Permin & Thomsen (1948), Svanberg (1948), Bisch (1950), Holtz (1950), Wulff (1950), Trolle (1950), Fabricius-Möller & Oram (1951), Oram (1951), Granzow (1951), Mauléon (1952), Engel (1953), Hoyme (1954), Asplund & Bryhn (1956), Wolter & Roesler (1956), Roth (1956), and Kolstad (1958). In the majority of these authors' series, however, the percentages of complications were higher than in the present investigation. The reported incidences varied from 2 or 3 to upwards of 15 per cent.

Spitzer (1933), Haugwitz (1935), Fuchs (1939), Holtz (1950), Wulff (1950), Granzow (1951), Kolonja & Ulm (1952), Asplund & Bryhn (1956) and Roth (1956) reported, following vaginal hysterotomy, incidences of up to 5 per cent or approximately the same as that in the present series; but higher incidences were found by Brosset (1946), Bengtsson & Sjöstedt (1948), Mauléon (1952) and Zetzman (1955).

Following abdominal hysterotomy and sterilization, Waldhard & Burkhard (1932) and Bengtsson & Sjöstedt (1948) reported incidences of 2—3 per cent, approximating the present figures, but Jerlow (1943), Brosset (1946), Svanberg (1948), Fabricius-Möller & Oram (1951), Mauléon (1952) and Kolstad (1958) had figures of bet-

ween 5 and 9 per cent. In calculating the incidence of complications in the present series, those referable to the abdominal wounds in six cases were not taken into account.

Feniger & Wetterdal (1947) found only five patients with complications in a series of 232 cases, the great majority of which had undergone dilatation of the cervix and curettage, vaginal hysterotomy, or abdominal hysterotomy and sterilization.

The observations reported from Russia by Mayer (1933) were difficult to evaluate, the incidence of complications varying widely between different series.

In the above comparisons the temperatures, as a rule, were not considered. Jerlow (1943), Permin & Thomsen (1948), Bengtsson & Sjöstedt (1948) and Bisch (1950) reported temperatures exceeding 38° in between 6 and 8 per cent after dilatation of the cervix and curettage. Holtz (1950), Engel (1953) and Asplund & Bryhn (1956) found that fairly pronounced temperature reactions were rare. In vaginal hysterotomy series reported by Feniger & Wetterdal (1947), Holtz (1950), Wulff (1950) and Kolonja & Ulm (1952) corresponding reactions showed only a low incidence; while in Asplund & Bryhn's investigation relatively high postoperative temperatures were far more rare than in the present series. In the latter, most of the patients received estrogenic hormone in connection with the operations. According to von Friesen (1954) patients treated in this way develop high temperatures less often than untreated cases. The patients in Holtz' (1950) series had not received this therapy; yet he had only a few cases with fairly high postoperative temperatures. It would seem that such temperatures were somewhat more common in the present series than in a number that have been reported earlier. On the other hand the series, as a rule, were not fully comparable. In some of them, for instance, postoperative fever was recorded only if temperatures exceeding 38° had been registered at least twice, but in other instances even similar temperatures on a single occasion were taken into account.

On the whole, the series reported here does not appear to differ fundamentally from most others with regard to the incidence of postoperative complications. It was too small for any reliable

comparison with other series in regard to the observed mortality of 0.7 per cent for legal abortion and sterilization. K l i n t s k o g (1952) gave a corresponding figure of 0.35 per cent in a major Swedish series referable to the period 1946—1951.

In this investigation complications in general, following vaginal hysterotomy, appeared to be independent of the duration of the interrupted pregnancy. This accords with observations made by M a u l é o n (1952). Thirteen patients underwent second operations shortly after vaginal hysterotomy; they had hemorrhages requiring re-suture or re-curettage. One of these patients developed salpingitis, but she had suffered from that condition even before the legal abortion. These complications and further operations, therefore, are not likely to have increased appreciably the danger of genital tract infections in connection with the legal abortion. However, the series was not sufficiently extensive for any definite conclusions to be drawn in this respect.

As pointed out in the foregoing, the majority of patients with complications following the operations of 1952 and 1953 were followed up, usually 1—5 years later. This also applied to cases with fairly pronounced temperature reactions postoperatively. In vaginal hysterotomy with or without dilatation of the cervix, 84.6 per cent of all cases were followed up; of all patients with temperatures exceeding 38° or elevated for at least one week after the aforementioned operation, 83.6 per cent were followed up. As regards the incidence of the complications and fairly pronounced temperature reactions after the operations of 1952 and 1953, the followed-up cases therefore appeared to be representative of the original series.

SUMMARY

Immediate serious complications occurred in 3.6 per cent of all cases, including 3.7 per cent of patients who had undergone vaginal hysterotomy without dilatation of the cervix and in a few patients following other types of operations. One patient died from intraperitoneal hemorrhage — the only death directly associated with the operation. She had undergone legal abortion and sterilization.

Factors such as the number of previous childbirths or the duration of the interrupted pregnancy did not demonstrably influence the incidence of complications following vaginal hysterotomy.

Previous vaginal hysterotomy could not be shown to heighten the risk of complications after further operations of the same type.

As regards the incidence of complications, the present series showed no major divergence from others reported earlier.

III. Results of Examinations about Three Weeks after Operation

Where possible, the patients were asked to attend for examination about three weeks after the operations. These examinations were carried out at the outpatient departments of the same hospitals by between 30 and 40 gynecologists. Any painful conditions were registered and the patients underwent conventional clinical examinations. The results are set forth in table 14.

The vesicovaginal fistula observed in one case was extremely narrow and easily closed by operative means.

It is evident from the table that the great majority of patients with disturbances three weeks after operation had undergone vaginal hysterotomy, and that most of them were subsequently followed up, usually 1—5 years after operation.

Of the 1,133 patients examined three weeks or, in one case, three months after operation, 80 reported earlier salpingitis and seven cervicitis or endometritis. Of the 20 patients with salpingitis or parametritis three weeks after the interruption of pregnancy, four said they had had salpingitis prior thereto; of 91 with cervicitis or endometritis three weeks after operation, nine spoke of earlier salpingitis and two of earlier cervicitis or endometritis.

The great majority of patients with inflammatory conditions of the genital organs during the subsequently interrupted pregnancy were examined three weeks after operation.

Table 14. *Results of examination three weeks after the operation.*

Findings on examination after 3 weeks	Operative methods							Total	
	Dilatation of cervix H. 13 and curetage	Dilatation of cervix H. 17 and curetage	Vaginal hysterotomy	Vaginal hysterotomy and dilatation of cervix	Abdominal hysterotomy	Abdominal hysterotomy and sterilization			Other legal abortions with sterilization
						Corporal incision	Isthmic incision		
Parametritis	—	—	4	—	—	—	—	4	
Salpingitis	—	—	15 (3)	—	—	1	—	16	
Cervicitis	—	2	70 (6)	2	—	3	1	78	
Endometritis	—	—	11	—	—	2 (1)	—	13	
Obscure abdominal pain	—	—	9 (2)	—	—	—	1	10	
Vesicovaginal fistula ..	—	—	1 (1) ¹	—	—	—	—	1	
No symptoms or findings	15	27	831	3	4	84	34	1,011	
Not examined	4	3	42	1	—	2	2	55	
Total	19	32	983	6	4	92	38	1,188	

N. B. Parenthesized figures refer to the number of cases of relevant complications which were not subsequently followed up.

¹ This case was examined about 3 months after the legal abortion.

Of the 81 who had cervicitis or endometritis three weeks after vaginal hysterotomy, one had suffered from gonorrhea during the subsequently interrupted pregnancy, and four had colpitis, cervical erosion or fairly pronounced fluor vaginalis at the time of the legal abortion.

An appreciable number of women with inflammatory conditions in the genital organs thus had histories of genital infections. The reported figures possibly suggest that earlier genital infections had played some role in the inflammatory conditions observed three weeks after operation.

The results of examination in cases with complications at, or directly following the operations are shown partly in table 15. One patient who had undergone re-suture of a ruptured abdominal wound was not available for examination. The others with post-operative complications who are not included in table 15 were examined and showed no appreciable disease.

Table 15. *Findings on examination after three weeks in cases of immediate complications.*

Immediate complication	Findings on examination				Not examined	Total
	Parametritis, salpingitis	Obscure abdominal pain	Cervicitis, endometritis	Negative		
Re-curettage with or without re-suture	—	—	2	3	—	5
Re-curettage and salpingitis	1 ¹	—	—	—	—	1
Major hemorrhage during operation	—	—	1	27	3	31
Endometritis ..	—	1	—	3	—	4
Salpingitis	1	—	—	3	1	5
Incomplete abortion	—	1	—	4	—	5
Obscure pain ..	—	—	2	13	—	15

¹ Patient claimed to have had salpingitis before the legal abortion.

From the foregoing and table 15 it is clear that 18 patients with salpingitis or parametritis and 86 with cervicitis or endometritis had no complications directly associated with the operations.

Postoperative temperature reactions in cases with inflammatory conditions three weeks after operation are shown in table 16.

Table 16. *Postoperative temperature in cases of salpingitis, parametritis, cervicitis or endometritis 3 weeks after the operation.*

	Temperature				Total
	≤ 37.5	$>37.5 \leq 38$	$>38 \leq 39$	$>39 \leq 40$	
Salpingitis, parametritis	6	12	2	—	20
Cervicitis, endometritis	21	52	13	5	91

One patient with cervicitis or endometritis and a temperature exceeding 38° had undergone re-curettage and re-suture; the other patients in table 16 with temperatures above 38° had shown uneventful early postoperative courses. Aside from one case with cervicitis or endometritis, all those in table 16 with temperatures exceeding 38° were afebrile within five days after operation.

It emerges from the above that in the majority of patients with inflammatory conditions of the genital organs three weeks after operation, the immediate postoperative courses had been quite uneventful.

Evaluation of the series is not likely to have been very uniform, since a large number of different gynecologists conducted the examinations. The majority of patients with disturbances observed three weeks postoperatively were subsequently followed up, in most cases 1—5 years after operation. As regards the incidence of the relevant disturbances the followed-up cases appeared to be representative of all patients examined after three weeks.

A total of 1,132 patients were accordingly examined about three weeks after operation. Sixteen of them then presented salpingitis, four parametritis, 78 cervicitis, and 13 endometritis. One patient

examined three months after operation had a vesicovaginal fistula. In most cases with these disturbances the immediate postoperative course had been uneventful; the great majority of them had undergone vaginal hysterotomy.

IV. Follow Ups about One to Five Years after Operation

As mentioned in the foregoing, 1,013 patients consented to undergo certain examinations relatively long after the legal abortions with or without sterilization. In most cases this period amounted to between 1 and 5 years. In the following the relevant operations are called operations or legal abortions of 1952—53. The 1,013 patients represented a like number of operations. They were considered, as pointed out earlier, representative of the original series. In 48 cases relatively incomplete data were obtained concerning their conditions following the operations. In addition a little information was gained, regarding a further number of cases, from the files of departments of obstetrics and gynecology in Stockholm to which the patients had later been admitted for various reasons. The known data on these two groups will be reported separately.

Besides the patient who died shortly after legal abortion and sterilization, four others died before this follow-up investigation was initiated. The causes of death were organic heart disease in one, chronic nephritis in one, and suicide in two. None of these four women died less than two months after the legal abortions. From the somatic standpoint there was no demonstrable connection between the operations as such and the patients' deaths.

The original aim, as mentioned in the foregoing, was to follow up the patients about one year after the legal abortions. Considerable difficulties were often encountered, however, due mainly to the patients' lack of cooperation. Hence, the investigation frequently required a much longer time; many patients could not be followed up until about 4 years after operation.

All of the 1,013 patients were, throughout, examined by the author. Each of them was subjected to gynecologic examination. About 850 of them underwent two such examinations; approximately 150 were submitted to the same examination at least three times. The aim was to investigate further those patients who were not pregnant at the time of the clinical examination or had not had full-term pregnancies in the interval between legal abortion and examination. This further investigation was to comprise hysterosalpingography and endometrial biopsy. In numerous cases it was hoped to take biopsies from the hysterotomy scars. Many patients refused these examinations, and in a few others they were inadvisable on medical grounds. In numerous cases, therefore, examinations to the extent envisaged were impracticable.

Prior to hysterosalpingography and endometrial biopsy, any inflammatory conditions of the vagina and cervix were treated. For these two types of examination, non-sterilized patients and a few of the sterilized ones were admitted to the Department of Women's Diseases of Karolinska Sjukhuset. With a few exceptions they received penicillin during hospitalization and penicillin preparations with a depot action on the day of their discharge.

Hysterosalpingographies were usually performed with the technique reported by Kjellberg (1942); in a somewhat smaller number of cases, with a modification of that technique. In the majority, satisfactory contrast filling of both fallopian tubes was obtained; in several, however, the radiographic examination was discontinued prior thereto; and in a further number there was no satisfactory contrast filling of either tube. Twenty-two patients were accordingly subjected once more to hysterosalpingography with larger amounts of contrast medium than before. Two of these 22 underwent hysterosalpingography yet again later on. In a few cases the examination was performed with the help of an instrument, reported by Kjellman (1953), that adheres by suction to the portio; but in the great majority, with the aid of an instrument described by e.g. Kjellberg (1942). In most patients this instrument occupied the greater part of the cervix; and for this reason no information could be gained regarding the presence of lesions there. In the first 40 cases the contrast medium employed was Umbradil Viskös H. (Morales & Heiwin-

kel, 1948; Morales, 1949); in the remaining 720 cases, Perjodal H. Viskös, 35 per cent. This latter agent differs from Umbradil Viskös H., *inter alia*, in that diethanolamine salt of 3,5-di-iodo-4-pyridon-N-acetic acid 0.35 g is added, instead of to carboxymethyl cellulose, to dextran of low molecular weight dissolved in sterile water to 1 ml. The results of hysterosalpingographies were evaluated largely on the basis of observations reported by Kjellberg (1942), Shanks & Kerley (1950), Schinz (1952), and Asplund (1952).

Endometrial biopsies were generally taken one or two days after the hysterosalpingographies, though in patients with relatively pronounced temperature reactions following the latter, not until one of the subsequent menstrual cycles. Hysterosalpingography and endometrial biopsies were performed, as a rule, during the latter half of a menstrual cycle since one aim of the investigation was to establish, with the aid of endometrial studies, whether ovulation had occurred. Not infrequently, however, the patients' own wishes with regard to the time of the examination had to take precedence. This applied in particular to non-sterilized patients, who were of course hospitalized for the examinations. A number of patients therefore underwent these examinations during the first half of a menstrual cycle or approximately midway through one. In order to establish whether ovulation had occurred, further endometrial biopsies were accordingly required in many cases; as a rule they were taken during subsequent menstrual cycles.

Endometrial specimens and biopsy specimens from hysterotomy scars, uterine cervix and urinary bladder were examined at the Pathology Department of Karolinska Sjukhuset. Cyclic changes in the endometrium were evaluated largely in accordance with the criteria reported by Novak (1947). In a number of cases where further studies were required, they were carried out by one and the same examiner according to the general principles drawn up by Noyes, Hertig & Rock (1950). The same examiner also studied the greater part of all biopsy material from lesions in which endometriosis was suspected. The 1,013 cases in which clinical examinations were carried out are listed in table 17. By follow-up time is generally meant the period that elapsed between the legal abortion and the first clinical examination, though in

patients who also underwent hysterosalpingography the period ending with the latter. In the sequel, the follow-up times are those specified in the table, unless otherwise stated.

Table 17. *The followed-up series, tabulated with reference to operative methods and follow-up times.*

Operative methods	Period between operation and follow up				
	0—1 year	1—2 years	2—3 years	3—4 years	Total
Dilatation of cervix H. 13 and curettage	—	10	3	—	13
Dilatation of cervix H. 17 and curettage	—	21	4	2	27
Vaginal hysterotomy	8	714	74	37	833
Vaginal hysterotomy and dilatation of cervix	—	4	—	—	4
Abdominal hysterotomy ..	—	3	1	—	4
Laminaria dilatation, curet- tage and bilateral salping- ectomy	—	6	1	—	7
Other legal abortions per vaginam and sterilization via laparotomy	—	2	1	1	4 ¹
Abdominal hysterotomy (isthmie incision) and sterilization	—	28	7	1	36
Abdominal hysterotomy (corporeal incision) and sterilization	2	77	5	1	85
Total	10	865	96	42	1,013

¹ Vaginal hysterotomy in three; dilatation of cervix and curettage in one.

In the following, vaginal hysterotomy cases include those, too, that also underwent dilatation of the cervix, unless otherwise stated.

Many patients were subsequently asked to furnish additional information. For certain reasons it was of great interest to secure longer follow-up times for some parts of the series. Many patients were accordingly followed up for a few years. Four or five years

after the legal abortions, certain information was requested from the great majority of the 840 patients who had undergone vaginal hysterotomy in 1952 or 1953; and 575 of them provided the required data. Partly on the basis of the information thus obtained, it was sought to examine a number of these patients, 116 of whom were in fact followed up four or five years after the legal abortion. The particulars requested were obtained chiefly from patients who had earlier undergone hysterosalpingography and endometrial biopsy; more rarely some information was given by patients who had refused to undergo these examinations and by others who had had full-term pregnancies in the interval between legal abortion and the first examination.

It is evident from the foregoing that over the course of a few years the examiner was repeatedly in touch with the same patients. The intervals varied from a week or so to two or three years. These patients remarkably often gave, from one time to another, widely varying reports of symptoms referable to the genitourinary tract. This even applied when the intervals were relatively short. Numerous patients furnished extremely vague information, which in some cases was found to be quite erroneous. In view of the above, the patients' own statements were regarded as somewhat unreliable. In analyzing the series, attention was chiefly given, therefore, to the observations made with the aid of methods designed to demonstrate somatic disturbances in the genitourinary organs. In the following, some space will be devoted to the incidence and nature of those symptoms referable to the genitourinary tract that developed or were aggravated after the legal abortions, and to the results of examinations in such cases. Where such symptoms occurred in patients with endometriosis they will be reported, however, in conjunction therewith.

In the analysis of the series, a graphic method (binomial paper), reported by Mosteller and Tukey (1946, 1949), was employed for comparison of two or more percentages. Where this method was inadequate, Cramér's (1945) χ^2 test was used.

A. PATHOLOGIC CHANGES IN THE VAGINA AND CERVIX, EXCLUDING HYSTEROTOMY SCARS AND ENDOMETRIOSIS

1. Prolapse of the Vagina and Uterus

Prolapse of the vagina was found in 118 patients, a small number of whom also had uterine prolapse. In the majority of cases there were only minor cystoceles, though in 26 more marked prolapse with at least an egg-sized cystocele or appreciable descent of the uterus.

Prolapse was present in 82 of the 840 patients, listed in table 17, who had undergone a vaginal hysterotomy in 1952 or 1953, and in 36 of the 173 with other operations. It was found only in those who had borne children. The incidence of prolapse in relation to the number of vaginal hysterotomies in parous women will be seen from table 18, which does not include patients who had childbirths or vaginal hysterotomies in the interval between legal abortion of 1952—53 and follow up.

Table 18. *Incidence of prolapse in relation to the number of vaginal hysterotomies carried out.*

Number of vaginal hysterotomies	Total of cases	Cases of prolapse	
		Number	%
0	87	26	29.9
1	445	59	13.3
≥ 2	76	15	19.7

The table shows that prolapse was not commoner in women who had undergone one or two vaginal hysterotomies than in those without any such operations. Vaginal hysterotomy, in which the lower part of the urinary bladder is mobilized, accordingly was not found to be a predisposing factor in prolapse.

In most cases the follow-up time did not exceed two years. Possibly it was too short for lesions associated with the operation to have contributed to prolapse.

Other types of operations such as dilatation of the cervix and curettage, and abdominal hysterotomy, in most cases with surgery of the fallopian tubes, are unlikely to have had any major significance in the development of prolapse. Nothing was known regarding the occurrence of prolapse prior to the legal abortions of 1952—53.

The last-named operations, as will be evident from the above, could not be shown to have promoted the development of prolapse.

2. *Deformation of the Portio Vaginalis*

Deformation of the portio vaginalis was observed in four patients, all of whom had undergone vaginal hysterotomy in 1952 or 1953.

One patient had a cicatrized anterior cervical wall that was split in the midline from the external os 3—4 cm up. At the legal abortion a fistula had been found, extending through a cicatrized anterior cervical wall, and probably resulting from an earlier vaginal hysterotomy. This patient later had a normal pregnancy.

One patient showed a very thin anterior lip. She had earlier had a childbirth but no other operation than the legal abortion. The cause of the change was unknown.

In two patients the anterior lip was split in the sagittal plane to a depth of about 5 mm. One of these two had previously undergone childbirth and criminal abortions; in the other the anterior lip had been injured at the legal abortion.

No patient showed signs of inflammatory processes in the genital organs at the follow up, and no patient had been involuntarily sterile.

In two cases, lesions had accordingly resulted from the legal abortions. In the other two, both with very slight deformation, the latter's mode of origin was unknown. The lesions were not found to have increased the disposition to genital tract infections or to have caused sterility. The follow ups thus disclosed that vaginal hysterotomy may, in exceptional cases, result in deformation of the portio vaginalis. This change was not found to be of any appreciable significance.

3. Fistulae through the Anterior Cervical Wall

Five patients who had undergone a vaginal hysterotomy in 1952 or 1953 had a fistula 2—3 mm wide through the anterior wall of the cervix, extending from the upper part of the cervical canal through the hysterotomy scar into the anterior vaginal fornix. In a sixth case a similar fistula had been operatively closed during the interval between vaginal hysterotomy and the follow up.

Prior to the legal abortions of 1952—53, two patients had not had any pregnancy or operation on the vagina or cervix; one had undergone a vaginal operation for prolapse as well as vaginal hysterotomy. In the latter case the anterior cervical wall had been found cicatrized and friable at the time of the legal abortion. Another patient had previously had at least four criminal abortions.

At the follow up, cervical erosion was found in one case and inflammatory changes in the fistular wall in another. Otherwise these six patients showed no other lesions than the fistulae, excluding the hysterotomy scars. Two of the five with fistulae observed at follow up subsequently had normal pregnancies, including the one with inflammatory changes. None of the patients had been involuntarily sterile.

In view of the localization of these fistulae, it seemed evident that they had resulted from vaginal hysterotomy. In one case there had evidently been anatomical changes conducive to development of the fistula. Apparently the fistulae had not appreciably reduced the fertility, since two of the five patients with open fistulae later had pregnancies. Due to the small number of cases, it could not be decided if these fistulae had predisposed to infections in the cervix.

A fistula through the anterior cervical wall thus arose in six of the 840 patients who had undergone a vaginal hysterotomy in 1952 or 1953. The lesions had no demonstrable significance from the standpoint of fertility.

4. *Acute Cervicitis and Cervical Erosion*

Acute cervicitis was found in two patients. One of them had shown no signs of inflammatory conditions involving the genital organs when examined earlier, though a considerable time after the legal abortion. The other had had a normal pregnancy and childbirth in the interval between legal abortion and follow up. In view of the considerations mentioned above, it seemed very uncertain whether the legal abortions had any causal relationship to the cervicitis in these two cases.

Cervical erosion was present in 66 patients, i.e., 6.5 per cent of the 1,013 cases. Two of them had undergone dilatation of the cervix and curettage, 53 vaginal hysterotomy, nine abdominal hysterotomy and sterilization, and two laminaria dilatation, curettage and sterilization in 1952 or 1953. At the time of these operations, two were gravida I. Seven had cervicitis when examined three weeks after the operations; in the remainder no postoperative complications or inflammatory conditions at that time had been observed. Of the patients who underwent vaginal hysterotomy in 1952—53, one had cervical carcinoma at the follow up, and another had had a genital tract infection between the legal abortion and the follow up. These 66 patients showed no other signs of genital tract infection when followed up.

The two patients who had undergone dilatation of the cervix and curettage became pregnant after the follow up. Of the 53 who had been subjected to vaginal hysterotomy, nine had been pregnant between that operation and the follow up: some of these and 16 others became pregnant after the follow up. At the latter, most cervical erosions were treated with silver nitrate; those patients who had not been pregnant between the legal abortion and the follow up, usually received penicillin treatment for two or three days in connection with hysterosalpingography. Patients with cervical erosions had not been involuntarily sterile after the legal abortions of 1952—53.

Nothing was known regarding the occurrence of inflammatory conditions in the cervix prior to the operations of 1952—53. Earlier authors have shown that these conditions are common; in

some previous investigations they were observed at least as often as in the present series (K l e e g m a n, 1940; W h a r t o n, 1947; H a h n, 1948; H a m m e n, 1952). It seemed unlikely, therefore, that the operations for interruption of pregnancy and, in some cases, sterilization had essentially increased the disposition to such infections that produce erosions.

Some had had pregnancies or genital tract infections between the legal abortions and follow up; possibly these conditions had given rise to erosions in the relevant cases.

Nearly 50 per cent of the patients with erosions had pregnancies after the legal abortions, which fact suggests that the erosions did not substantially affect the fertility. According to authors such as S o l o m o n s (1952), B u x t o n & W o n g (1952) and H o r n & R o c k (1952), infections of the cervix have a deleterious effect on fertility. On the other hand, B u x t o n (1955) pointed out that cervicitis impaired fertility only if the properties of the cervical mucus were changed. According to B u x t o n & S o u t h a m (1956) and S t u r g i s (1956), mild pathologic states localized to the cervix alone are of no appreciable significance with regard to fertility. The patients reported here who had pregnancies after the follow up, had received, at the latter, some local treatment of the erosions and usually a few days' treatment with penicillin. This therapy was of such nature, however, that it could scarcely have influenced fairly pronounced inflammatory conditions to any major degree.

Acute cervicitis was thus present in two cases; cervical erosion in 66, i.e., 6.5 per cent of all followed-up cases.

These lesions could not be shown to have resulted from the legal abortions; nor to have fundamentally impaired the fertility.

B. ENDOMETRIOSIS IN VAGINAL HYSTEROTOMY SCARS AND ADJACENT PARTS OF THE UTERUS AND URINARY BLADDER

In the 885 patients who had undergone at least one vaginal hysterotomy there was observed, as a rule, a transverse scar, and in a few cases a scar running in the midline of the vaginal wall

on the anterior surface of the cervix. This scar had the appearance of a firm, often irregular infiltration varying in extent from case to case. Usually it was fixed to the cervix, which then appeared swollen and somewhat increased in breadth. When biopsies were taken, it was often impossible to detect any clear boundary between scar tissue and cervical tissue. The upper limits of the scar frequently extended to the urinary bladder or up between the latter and the cervix.

In many of the scars were observed changes that grossly resembled endometriosis; for instance, friable, superficial purple cysts approximating grains of rice in size. In other cases bluish cyst-like formations with thick blue-brown contents were found very near the surface or deeper in the scars. The last-named changes sometimes extended to the lower borders of the urinary bladder or into the cervical wall. From many of them there proceeded narrow, bluish, fistula-like passages, extending far into the scar tissue or into the cervical wall. Sometimes they were impossible to follow throughout their course. These lesions were occasionally so marked as to impart a worm-eaten appearance to the scars.

In patients who raised no objection, excisions were made or biopsies taken from the endometriosis-like lesions and, in a few cases, from more discrete elevated areas in the scar that otherwise showed no gross signs of endometriosis. Since excisions or biopsies were not always possible on the scale desired, the actual extent of the observed changes was sometimes uncertain. The diagnosis of endometriosis was based on the results of microscopic examination of excised tissue.

1. Results of the First Investigation Comprising the Total Series

a. Appearance of the Scars and Incidence of Endometriosis

Tables 19 and 20 show the appearance of the scars and the incidence of endometriosis in the 840 patients who underwent vaginal hysterotomy in 1952—53, and in 45 patients who were subjected to the same operation at some other time, though not in 1952 or 1953.

Table 19. *Appearance of hysterotomy scar and results of biopsies in cases of vaginal hysterotomy in 1952-53.*

Findings at vaginal examination	Total of cases	Number biopsied	Results of microscopic examination					Scar tissue, squamous epithelium
			Endomet-riosis	Corpus glands	Cervical glands	Endometriosis or gartnerian cyst	Myoma, inclusion cyst, gartnerian cyst	
No scar	9	—	—	—	—	—	—	—
Fine, slightly elevated scar	519	—	—	—	—	—	—	—
Moderately elevated scar	133	12	7	—	—	—	2	3
Greatly elevated scar	18	5	4	—	—	—	—	1
Grossly suspected endometriosis in elevated scar	88	79	72	3	—	—	1	3
Grossly suspected endometriosis in fine scar	73	64	57	1	1	2	—	3
Total	840	160	140	4	1	2	3	10

Table 20. *Appearance of hysterotomy scar and results of biopsies in cases of vaginal hysterotomy at some time other than 1952-53.*

Appearance of scar	Total of cases	Biopsies	Endometriosis
No scar	4	—	—
Slightly elevated scar	18	—	—
Moderately elevated scar	9	—	—
Greatly elevated scar	1	1	1
Grossly suspected endometriosis in elevated scar	7	6	6
Grossly suspected endometriosis in slightly elevated scar	6	5	5
Total	45	12	12

It is evident from table 19 that in four patients only corpus glands were observed in excised tissue and no stroma; the microscopic findings there were considered suggestive of endometriosis. These lesions will be regarded, in the following, as endometriosis. One patient with a moderately elevated hysterotomy scar had undergone, between the legal abortion and follow up, an operation for endometriosis in that scar and adjacent parts of the urinary bladder; she now presented no endometriosis-like changes in the scar. Another who, prior to the follow up, had undergone an unknown type of operation for lesions of the anterior vaginal fornix, now showed a greatly elevated scar without endometriosis-like changes; but she had endometriosis in an area of the bladder wall corresponding to the scar.

It is clear from the foregoing that on the above basis of evaluation, endometriosis was found in the hysterotomy scar, cervix or bladder wall in 146 patients, or 17.4 per cent of the 840 who had undergone vaginal hysterotomy in 1952-53, if these included the above-mentioned case that was operated on, between the legal abortion and follow up, for endometriosis in the hysterotomy scar and urinary bladder. Endometriosis was observed in 158 of the 885 cases in which vaginal hysterotomy had been performed at some time or other.

In 157 of these 158 patients with endometriosis in hysterotomy scars or adjacent parts of the cervix or urinary bladder, there was no evidence of the same condition at any other site. In one case endometriosis-like lesions were detected in a fallopian tube at hysterosalpingography, but the diagnosis could not be verified.

b. Incidence of Endometriosis in Relation to Number and Types of Legal Abortions and Other Traumatizing Factors

The distribution of the 158 patients with endometriosis in relation to the various operations will be seen from table 21.

It emerges that endometriosis of the vaginal wall, cervix or urinary bladder was not found in any of the 127 patients who had

Table 21. *Incidence of endometriosis of the vagina, cervix and urinary bladder in relation to the number of vaginal hysterotomies which had been undergone.*

Operative methods	Total of cases	Number with endometriosis	Superficial localization	Deep localization	Cases of endometriosis %
Vaginal hysterotomy					
1952—53 only	727	113	69	44	15.5
Vaginal hysterotomy 1952—53 and earlier	93	31	20	11	33.3
Vaginal hysterotomy 1952—53 and later	14	2	1	1	14.3
Vaginal hysterotomy 1952—53 and earlier and later	4	—	—	—	—
Vaginal hysterotomy 1952—53 and possibly earlier, and later	2	—	—	—	—
Vaginal hysterotomy earlier but not 1952—53, though in two cases later	45	12	8	4	26.7
Vaginal hysterotomy possibly earlier	1	—	—	—	—
No vaginal hysterotomy ..	127	—	—	—	—
Total	1,013	158	98	60	

never undergone vaginal hysterotomy but it was observed in 158 of the 885 who had been subjected to at least one such operation. This difference in the incidence of endometriosis was statistically significant ($p \leq 0.001$).

Of the 885 patients who had undergone vaginal hysterotomy, 685 had had no other operation on the genital organs. In 124 of these latter cases, or 18.1 per cent, endometriosis was found. Of the 200 patients who had also had other operations on the genital organs, 34 or 17 per cent showed endometriosis. Those who had had no other operation than vaginal hysterotomy accordingly presented endometriosis at least as often as those with other operations too. No patient with endometriosis had previously undergone any operation on the urethra or urinary bladder, aside from the two who, between the legal abortion and follow up, had been submitted to surgical measures for endometriosis in the hysterotomy scar and bladder, and an operation of unknown type in the anterior vaginal fornix, which possibly involved the urinary tract.

In 23 patients with endometriosis who had been pregnant and had undergone a vaginal hysterotomy in 1952—53, there had, neither before nor later, been any other pregnancy or any other operation on the genitourinary organs.

In 35 of the 45 patients who had been subjected to at least one vaginal hysterotomy, though not in 1952 or 1953, that operation had been performed once only. Nine of them, or 25.7 per cent, showed endometriosis in the hysterotomy scars.

The above findings definitely point to a connection between operations of the vaginal hysterotomy type, performed on the pregnant uterus, and the occurrence of endometriosis with the relevant localizations.

c. Influence of Various Factors on the Incidence of Endometriosis in Hysterotomy Scars, Cervix or Urinary Bladder Following Vaginal Hysterotomy

To evaluate the causal significance of various factors in endometriosis, a series was taken which consisted of patients who had undergone only one vaginal hysterotomy, in 1952 or 1953. From it were discarded those in whom the incision had been made in the

isthmus region at abdominal hysterotomy, those with amenorrhea between the operation and follow up, and those who were or had been pregnant during that period. However, seven patients were included who, at the examination, had not more than three weeks' amenorrhea due to pregnancy but showed no other definite signs of pregnancy. There remained for analysis 616 cases, including 100 with endometriosis. In the patient who, between the legal abortion and follow up, had been operated on for endometriosis in the hysterotomy scar and urinary bladder, the period from the legal abortion to that operation was regarded as the follow-up time. Unless otherwise stated, the following analyses were based on the above-mentioned 616 cases.

Incidence of Endometriosis in Relation to Age and the Number of Earlier Pregnancies at the Time of Legal Abortion. This incidence will be seen from tables 22 and 23.

Table 22. *Incidence of endometriosis in relation to patients' ages at the time of operation in 1952-53.*

Age at vaginal hysterotomy	Total of cases	Cases of endometriosis	
		Number	%
≤ 20	40	7	17.5
> 20 ≤ 30	264	52	19.7
> 30 ≤ 40	261	36	13.8
> 40	51	5	9.8
Total	616	100	

Table 23. *Incidence of endometriosis in relation to the number of earlier pregnancies.*

Number of earlier pregnancies	Total of cases	Cases of endometriosis	
		Number	%
0	138	26	18.8
1	123	20	16.3
2	158	27	17.1
3	106	15	14.2
≥ 4	91	12	13.2
Total	616	100	

In these tables no statistically significant difference was found in the incidence of endometriosis between the various groups of cases. Neither the age at legal abortion nor the number of earlier pregnancies seemed, therefore, to have any appreciable bearing on the occurrence of endometriosis in the hysterotomy scars and adjacent organs.

Incidence of Endometriosis in Relation to Certain Surgical Complications and to Postoperative Estrogen Therapy. Of the 840 patients who had undergone vaginal hysterotomy in 1952—53, two were subjected to re-curettage and 10 to re-suture with or without re-curettage. One of the two first-named patients had endometriosis in the hysterotomy scar. In two cases hematuria developed following the vaginal hysterotomy; one of them showed endometriosis in the scar. Of these 14 patients one had been pregnant between the legal abortion and follow up and one had also undergone vaginal hysterotomy previously; neither of them now had endometriosis. Aside from the case of pregnancy, amenorrhea had not been present in these patients since the legal abortions of 1952—53. The number of cases with the above-mentioned complications was too small for evaluation of the degree to which the complications had increased the chances of endometriosis.

Most of the patients received estrogenic agents during the first few days after the operations. Of 593 who had been under this medication, 96 (16.2 per cent) had endometriosis; of the 23 who had not, four (17.4 per cent) showed endometriosis. Judging by these figures, treatment with estrogenic hormone was of no significance in the development of endometriosis.

Incidence of Endometriosis in Relation to Follow-up Time and Duration of the Interrupted Pregnancy. This incidence is evident from table 24.

According to the table, endometriosis showed a higher percentage in patients with longer follow-up times. A statistically significant difference in the incidence of endometriosis was found between cases with follow-up times of 1—2 years and those with corresponding periods of 2—3 years ($p \leq 0.001$). On the other hand, the stage of pregnancy at which the operation was performed had no demonstrable bearing on the occurrence of endometriosis.

Table 24. *Incidence of endometriosis in relation to follow-up time and duration of pregnancy prior to interruption.*

Duration of pregnancy		Follow-up time						All cases		
		0-1 year		1-2 years		2-3 years		3-4 years		
		Total of cases	Number with endometriosis	Total of cases	Number with endometriosis	Total of cases	Number with endometriosis	Total of cases	Number with endometriosis	
9-12 wks		—	—	20	3	1	—	3	24	12.5
13-16 wks		—	—	226	37	17	6	8	251	18.7
17-20 wks		2	1	286	36	18	7	8	314	15.0
21-24 wks		—	—	23	3	1	—	2	26	11.5
25-28 wks		—	—	1	—	—	—	—	1	—
Total	2	1	556	79	37	13	21	616	100	
Cases of endometriosis in %			14.2		35.1		33.3		16.2	

Localization and Extent of Endometriosis in Relation to Follow-up Time. Of the 100 endometriosis cases listed in table 24, 20 had deep and extensive lesions. As extensive lesions were regarded cyst-like formations with diameters of about 1 cm or more, conglomerations of several smaller lesions, sometimes with fistula-like tracts, and lastly endometriosis in or contiguous to the bladder wall. The incidence of these changes in relation to the follow-up time is shown in table 25.

Table 25. *Incidence of extensive endometriosis, located deep in hysterotomy scar, in relation to follow-up time.*

Follow-up time in years	Total of cases of endometriosis	Cases of deep and extensive endometriosis	
		Number	%
1—2	79	11	13.9
2—3	13	5	38.5
3—4	7	4	57.1

It emerges that deep and extensive endometriotic lesions showed a higher percentage in patients with longer follow-up times. However, the series was relatively small, and the actual extent of the lesions was sometimes uncertain. For this reason no definite conclusion was drawn from the above figures.

Incidence of Endometriosis in Patients Who had Undergone More than One Vaginal Hysterotomy. It is clear from table 21 that demonstrable endometriosis was much commoner in patients who had undergone a vaginal hysterotomy both in 1952 or 1953 and earlier than in those who had had that operation once only, in 1952 or 1953. In this comparison, however, the fact that the series differed in several respects was not taken into account. Neither the duration of the follow-up times nor the occurrence of pregnancies after the legal abortions was taken into consideration. Table 26 shows the incidence of endometriosis in patients who had undergone a vaginal hysterotomy both in 1952 or 1953 and earlier, with reference to the follow-up times as from each

of those operations. Excluded from the table are patients who, since the earlier operation, had had other pregnancies than that interrupted in 1952 or 1953; also patients with amenorrhea following the first legal abortion and patients who were pregnant at the follow up. However, some were included who had not more than 3 weeks' amenorrhea of pregnancy.

Table 26. *Incidence of endometriosis in cases of vaginal hysterotomy in 1952—53 and earlier, followed up 1—2 years after the operations of 1952—53.*

Follow-up time as from earlier vaginal hysterotomy	Total of cases	Cases of endometriosis	
		Number	%
2—3 years	20	7	35.0
3—4 years	10	7	70.0
> 4 years	31	9	29.0

According to table 26, the incidence of endometriosis in patients with follow-up times of 2—3 and 3—4 years after the first of two vaginal hysterotomies amounted to 35 and 70 per cent respectively. Comparison of these figures with those for cases with the same follow-up times and included in table 24 — which comprises patients who had a vaginal hysterotomy only in 1952 or 1953 — showed no statistically significant difference ($p > 0.01$). The fact of having undergone more than one vaginal hysterotomy did not, therefore, demonstrably increase the chances of endometriosis. However, the series was too small for any reliable conclusions to be drawn.

Incidence of Endometriosis in Relation to the Technique Employed at Vaginal Hysterotomy. Five operators working at the same department and all possessing wide experience of vaginal hysterotomy, had each performed about 100 or more of the operations in the total series. Two of them, hereinafter referred to as operators I and II, often took less time with the operations

than did the other three. They closed the uterine wall with three or four isolated catgut sutures spaced at intervals of about 1.5 cm. The other three surgeons, referred to as operators III, IV and V, closed the corresponding wounds with a considerably higher number of similar sutures at more frequent intervals. In other respects no appreciable difference could be found between the operative techniques of these five surgeons. All of them had sought as far as possible to keep the surgical field free of fragments of decidua when closing the uterine and vaginal walls. There was no selection of operators. The incidence of endometriosis in relation to the surgeons performing the operations will be seen from table 27, the material for which was selected on the same principles as that, for example, in table 22, though it was limited to cases with follow-up times of 1—2 years.

Table 27. *Incidence of endometriosis in relation to operative technique.*

	Operator				
	I	II	III	IV	V
Total of cases	129	52	110	86	71
Number with endometriosis	28	11	7	5	6
% of endometriosis	21.7	21.2	6.4	5.8	8.5

It will be observed that substantial differences in the incidence of endometriosis existed between certain groups of cases. When cases operated on with the same technique were combined, the groups shown in table 28 emerged.

Table 28. *Incidence of endometriosis in relation to operative technique.*

	Operator	
	I, II	III, IV, V
Total of cases	181	267
Number with endometriosis ..	39	18
% of endometriosis	21.5	6.7

The table shows a much higher incidence of endometriosis in the cases of operators I and II, i.e., those in which the uterine walls were closed with relatively few sutures. The difference in this incidence was statistically significant ($p \leq 0.001$).

It was pointed out in the foregoing that the localization of endometriotic changes varied: some lesions were quite superficial; others were situated deeper in the hysterotomy scars. Of the endometriosis cases listed in table 28, 17 showed deep lesions. In the group of cases referable to operators I and II, deep lesions were found in 13 (33.3 per cent) of the 39 with endometriosis. In the group referable to operators III, IV and V the corresponding figures were four (22.2 per cent) of 18 cases. Since this series was relatively small and deep lesions may often have been overlooked, the above percentual discrepancy does not warrant any conclusions regarding the significance of operative technique for the localization of endometriosis.

Vaginal hysterotomy was performed under general anesthesia as a rule, though under local anesthesia in a number of cases. In the following calculations a series was used which had been selected in the same way as that set forth in table 27. Operator II, whose cases in table 27 exhibited a high incidence of endometriosis, employed local anesthesia in about 20 per cent; but operator III, with a low incidence, had a corresponding figure of about 40 per cent. In each operator's group, endometriosis was found at least as often in patients who had received local anesthesia as in others. The type of anesthesia accordingly seemed to have no fundamental bearing on the occurrence of endometriosis.

d. Symptoms due to endometriosis

In the course of the investigation, endometriosis was found to be the only lesion resulting from the operations of 1952—53 that had occurred in an appreciable number of cases; moreover it was a lesion of known character. Hence it seemed justified to report, in conjunction with endometriosis, the symptoms conceivably produced by that condition.

The following data concerning symptoms in the genitourinary tract and the results of examinations derive from the first follow-up investigation, which comprised the entire series and was conducted within 4 years after the operations of 1952—53. As will be pointed out later on in more detailed accounts of pathologic changes in cases with genitourinary tract symptoms that developed or were aggravated after the operations of 1952—53, it was frequently difficult to determine if claimed symptoms had actually resulted from the operations or were of appreciable intensity. In many cases, claimed symptoms were possibly due to operations, infections or pregnancies occurring during the follow-up period. Some patients with endometriosis who had undergone vaginal hysterotomy in 1952—53 but not earlier, showed increased symptoms or symptoms that had arisen directly after that operation. In these cases it seemed uncertain whether the symptoms were actually due to endometriosis.

As reported on page 50, endometriosis with the localizations in question was detected in 146 (17.4 per cent) of the 840 patients who had been subjected to vaginal hysterotomy in 1952—53. Fifty-six of these, including 13 (23.2 per cent) with endometriosis, claimed to have had metrorrhagia during the follow-up period. Furthermore, endometriosis was observed in 13 (21.3 per cent) of 61 patients with fresh or aggravated dysmenorrhea; in 12 (30 per cent) of 40 with fresh or aggravated lower abdominal pain of obscure nature; and in seven (20.6 per cent) of 34 with fresh or increased dyspareunia after the vaginal hysterotomies of 1952—53. In corresponding groups of patients who had undergone vaginal hysterotomy in 1952—53 but had none of the above symptoms, the incidence of endometriosis varied between 16.8 and 17.2 per cent. Somewhat lower incidences, though still higher in patients with than in those without the relevant symptoms, emerged when the calculations were limited to patients who had undergone a vaginal hysterotomy only in 1952—53.

Thirty-one patients claimed to have, or to have had, pollakiuria or dysuria, which symptoms had arisen or were aggravated after vaginal hysterotomy. In two cases there was endometriosis producing changes in the urinary bladder, but five patients had endometriosis limited to the hysterotomy scars. One of these five

had earlier undergone vaginal hysterotomy before the same operation in 1952 or 1953, and at subsequent follow up presented endometriosis of the bladder. Another patient was free of symptoms following removal of a large endometriotic lesion in the hysterotomy scar. In this case and the three others with bladder changes, it seemed probable that endometriosis had given rise to the urinary tract symptoms. These four patients had fairly pronounced symptoms of long duration. Endometriosis was present in a further three patients, but it was very doubtful if these had symptoms due thereto. In all three the lesions appeared to be quite small. In two of them the onset of symptoms had directly followed the legal abortions of 1952—53, though one of these two had also undergone vaginal hysterotomy earlier. In the third patient, with symptoms that had arisen shortly after enucleation of a myoma on the anterior surface of the cervix after the legal abortion, the follow up also disclosed endometritis and possibly an expansive process in one kidney.

Having regard to the above findings, it seemed most likely that urinary tract symptoms attributable to endometriosis were present only in four cases.

In the above report on symptoms possibly due to endometriosis, the extent of the latter was not taken into account. It seemed plausible to assume that more extensive lesions were of greater causal significance to the painful conditions than were small superficial lesions. However, no definite conclusions could be drawn in this respect, since the actual extent of the changes was often uncertain. It is evident from the foregoing that endometriosis was found somewhat more frequently in patients with metrorrhagia and those with various types of pain that had arisen or been aggravated after vaginal hysterotomy in 1952—53, than in others who had undergone the same operation. The reported figures were not, however, based on sufficiently reliable grounds for any assured conclusions. It nevertheless appeared likely that a small number of patients with metrorrhagia or pain had acquired those symptoms as a result of endometriosis.

2. *Results of Later Follow Ups*

One hundred and thirteen patients were followed up once more within 2 to 4 years after the vaginal hysterotomies of 1952—53. Twenty-five of them had shown endometriosis in the hysterotomy scars when followed up earlier. In 12 of these the lesions appeared to have increased somewhat in extent; one of these 12 now showed endometriotic involvement of the bladder wall. Endometriosis in hysterotomy scars was found in 14 of the 88 patients who had exhibited no such changes at previous follow ups.

Between 4 and 5 years after the vaginal hysterotomies of 1952—53, it was possible to contact, orally or in writing, 575 (about 68 per cent) of the total of 840 patients. These 575 included 153 of the 160 who had shown endometriosis at the previous follow ups. Of the three who had earlier presented endometriosis of the bladder wall, two were re-examined. Further follow ups were possible in 116 patients, 28 of whom had shown endometriosis in the hysterotomy scars at the previous examinations. Of the 88 who had earlier had no demonstrable endometriosis, one now presented endometriosis in the bladder wall and five in the hysterotomy scars. Four of these had undergone a vaginal hysterotomy only in 1952—53; the fifth two such operations. Of the 575 patients, 45 had pollakiuria or dysuria that had arisen or exacerbated since the previous follow ups. Forty-one of these, including 20 who had previously had, or now had, endometriosis in the hysterotomy scars, were subjected to cystoscopy. Of those with such endometriosis, one now showed involvement of the bladder wall, and two had distinct impressions in the bladder wall at sites corresponding to the changes in the hysterotomy scars. Bladder wall endometriosis was also observed in one patient without demonstrable lesions in the hysterotomy scar but with a moderate swelling on the anterior surface of the cervix corresponding to the localization of the bladder wall lesions. The swelling might well have been due to endometriosis in the hysterotomy scar. Some of the other patients had urinary tract infections.

The four patients with urinary tract symptoms who could not be examined had not previously shown endometriosis in the hysterotomy scars. Two of them were in advanced stages of pregnancy.

3. Results of All Follow Ups within Five Years after Vaginal Hysterotomy in 1952—53

Of the 840 patients who had undergone vaginal hysterotomy in 1952—53, 166 (19.8 per cent) had endometriosis in the hysterotomy scars, the cervix or the urinary bladder.

Endometriosis in or contiguous to the bladder wall was found in seven patients, four of whom had undergone two vaginal hysterotomies. In all cases the lesions were apparently localized to the trigonal region, with no involvement of the ureteric orifices. There appeared to be a direct transition between endometriosis in the hysterotomy scars (five cases), or more pronounced swellings therein (two cases), and the lesions in or adjacent to the bladder wall.

Some contact was established with 575 patients 4 to 5 years after the operations of 1952—53. One patient with endometriosis in the hysterotomy scar and urinary bladder when examined 2—3 years after the legal abortion, could not be followed up later. If this case be included, endometriosis in or contiguous to the bladder wall was present in seven of 576 patients (1.2 per cent) 4—5 years after the vaginal hysterotomies of 1952—53.

From the reports of the results it will be observed that the great majority of patients who, at earlier examinations, had shown endometriosis in the hysterotomy scars underwent some form of follow up 4—5 years after the vaginal hysterotomies of 1952—53. It is further evident that endometriosis was found, at subsequent examinations, in hysterotomy scars and in or contiguous to the bladder wall in patients who had not exhibited such lesions at earlier examinations. There appeared to be a direct transition between the lesions in the scars and those in or adjacent to the bladder wall. It seemed likely that the reported incidence of endometriosis in or near the bladder wall (1.2 per cent of 576 cases) was too low, since the pertinent investigation was largely based on the patients' own statements, and cystoscopy was performed only in relatively few cases.

DISCUSSION

Judging by available data in the literature, endometriosis relatively seldom occurs in the anterior vaginal wall or in the cervix or urinary bladder, and is commonest in women who have borne children or undergone operations in those regions. The literature mentions only a few cases of endometriosis with those localizations in women who had undergone no operations, though most of these patients had borne children and had possibly sustained injuries with a causal relationship to endometriosis (Lash & Rappaport, 1943; Everett, 1944; O'Connor & Greenhill, 1945; Blaikley, 1949; Ranney & Chung, 1952; Zweibel, 1953; Ajamil, Pernas & Valverde, 1954; Williams & Richardson, 1955; Crone-Münzebrock, 1956; Perez & Gori, 1957). There have been far more observations of endometriosis with the above localizations in women who had undergone operations on the vagina or uterus, though not vaginal hysterotomy (the aforementioned authors, with the exception of Blaikley, 1949; Ajamil, Pernas & Valverde, 1954; and Perez & Gori, 1957; also Hasselhorst, 1933; Döderlein, 1933; v. Mickulicz-Radecki, 1936; Kretschmer, 1945; Ockuly & Helweg, 1946; McDougall, 1949; Navratil, 1950; Scott & TeLinde, 1954; Kleine, 1955; Lehfeldt, 1955; Izaki & Numata, 1956; Patino, 1957; and Zoedler, 1957). Törnqvist (1949), Healy (1956), Nussbaum & Motylloff (1957) and Prince & Abrams (1957) reported cases of endometriosis in surgical scars in the vulva. Endometriosis involving the urinary tract probably is relatively uncommon: Beecham & McCrea (1957) were able to collect only 105 cases in the world literature, and added one personal case. Shock (1926), Richter (1949), Kolonja & Ulm (1952), Swanberg (1952), Brosset (1954), Gottlieb (1957), and Arén (1958) reported endometriosis of the vaginal wall and cervix in patients who had undergone interruption of pregnancy by means of vaginal hysterotomy; endometriosis involving the urinary tract or producing symptoms therein was described by Kolonja & Ulm (1951), Brosset (1954), Crone-

Münzebrock (1956), Secher (1956), Gottlieb (1957), and Kottmeier (1957). Antoine (1953) had observed, since 1945, a higher incidence of endometriosis involving the bladder. He was inclined to attribute this to an increased number of legal abortions by vaginal hysterotomy since the last world war.

Swanberg (1952) gave an incidence of at least 10 per cent, and Arén (1958) 5.6 per cent, for endometriosis in vaginal hysterotomy scars.

Several of the endometriosis cases following vaginal hysterotomy that were reported by earlier authors had extensive lesions that produced serious disturbances in the urinary tract.

In the present series the diagnosis of endometriosis was based on the results of microscopic examination of excised tissue. Even those lesions in which microscopic examination disclosed no stroma were regarded as endometriosis, for according to Novak (1947) a stroma is not always detectable in changes of endometriotic nature. The lesion, observed in one case, that was grossly indistinguishable from endometriosis and proved to be composed of cervical glands was not classed as endometriosis. Even if the contrary had been the case, it would not have changed the statistical significance of the observed differences in incidence.

Probably both the incidence of endometriosis and the extent of involvement were underestimated in this series. It was not possible to examine all patients at such phases of the menstrual cycle when any lesions would have been more readily detectable. According to observations by Hoffman, Ober & Schmitt (1953) small superficial changes, for example, would possibly have been detected to a greater extent had patients been consistently examined early in the secretory phase. Deeper lesions and changes involving the urinary bladder would possibly have been found more often had the patients been examined during the latter part of a menstruation or immediately thereafter. Neither biopsies nor cystoscopies were practicable on the scale desired.

According to observations reported by Green & Meigs (1954), it seemed probable that changes in the hysterotomy scars that were regarded as "superficial" were, not infrequently, associated with deeper lesions which had possibly been overlooked in

a number of cases. Objections might therefore be raised to the classification into "superficial" and "deep" lesions. However, it did not appear likely that superficial lesions in hysterotomy scars which otherwise were only slightly swollen would be associated to any major extent with deeper changes.

In evaluating the influence of various factors on the incidence of endometriosis it was desirable to secure as homogeneous a series as possible. In view of experiences reported by Karnaky (1948), Gainley, Keeler & Nicolay (1952), Haskins & Wolff (1953), Meigs (1953), and Scott & Wharton (1955), patients were therefore excluded who had been pregnant between the legal abortion and follow up, had had amenorrhea of long duration, or were in advanced stages of pregnancy at the time of the follow up.

The changes of pregnancy in the genital organs probably made endometriotic lesions of the vaginal wall and cervix difficult to detect. In calculating the incidence of endometriosis, some patients were nevertheless included who, at the follow up, were in early stages of pregnancy and, on clinical examination, presented no definite signs of pregnancy. The difficulties in detecting endometriotic lesions in these cases were not considered to be greater than in non-pregnant women. Nor was pregnancy in early stages considered to have affected any endometriosis to an appreciable degree.

It seemed highly probable that endometriosis had resulted from vaginal hysterotomies. The circumstances pointing in this direction were, *inter alia*, as follows: Endometriosis occurred in this series regardless of whether the patients had undergone other types of operations on the genital organs or not. It was found in patients who had neither had any pregnancy than that which was interrupted, nor any other operation on the genital organs than vaginal hysterotomy. The endometriotic lesions appeared to be localized to those parts of the genitourinary tract that were directly affected by the vaginal hysterotomy.

According to Ranney & Chung (1952) and Green & Meigs (1954), endometriosis is often localized to more than one site in the pelvis. The question therefore arose as to the possibility of some disposition to endometriosis. There was no evidence of this in the present series, for in no patient with endometriosis of the

vagina, cervix or urinary bladder was that condition demonstrable at other sites too.

Harbitz (1934), Vogt (1950), Levin (1954), and Scott & TeLinde (1954) showed that endometriosis can be transplanted. It was pointed out above that a causal relationship in all probability existed between vaginal hysterotomy on the pregnant uterus and the subsequent occurrence of endometriosis. The endometriotic lesions appeared to be confined to those parts of the genitourinary organs that were directly affected by the surgical measures. In view of the above considerations it seemed likely that the lesions of endometriotic nature had resulted from implantation of decidua due to the surgical measures.

According to experience reported by Hobbs & Bortnick (1940), postoperative estrogen administration possibly had a bearing on the development of endometriosis, although in the present series this could not be proved.

Scott & TeLinde (1954) showed that the outcome of experimental transplantation of decidua was more or less independent of the duration of the pregnancy from which decidua was taken, though with the exception that decidua from full-term or almost full-term pregnancy was difficult to transplant. Partly similar observations were made in the present series, for endometriosis occurred here irrespective of the durations of the interrupted pregnancies.

Endometriotic lesions are subject to cyclic changes of importance to their growth. Although, according to Novak (1947), substantial individual variations are found in this respect, it seemed natural that endometriosis would be a commoner finding in cases with longer follow-up times, i.e., patients who had had relatively numerous menstruations since the operations. Probably for the same reason, a greater percentage of deep and more extensive endometriotic lesions was found in patients with longer follow-up times. The significance of the follow-up period for the detection of endometriosis was also evident from the observations thereof at later examinations of patients who had previously shown no endometriosis.

The operative technique appeared to have a bearing on endometriosis. That condition was found far more often in cases where

the uterine wall had been closed with relatively widely spaced sutures than in others. The operators' own statements on the techniques employed probably have to be taken, however, with some reservation. It was questionable, for instance, whether any one operator had consistently used the same technique; whether more or less pronounced hemorrhage during the operations had not influenced the mode of closure of the uterine wall. Operations by the method that increased the chances of endometriosis, often took a shorter time than other operations. No other differences in *modus operandi* were demonstrable. All operators had sought as far as possible to keep the surgical wound free of decidua fragments when closing it. According to observations made by W e s p i & K l e t z h ä n d l e r (1940), this should have helped to reduce the danger of endometriosis. Insofar as the available data on the operative technique were accurate, the observed difference in the incidence of endometriosis could scarcely have had any other explanation than the passage of decidua fragments through the sparsely sutured uterine wall, perhaps more often in such cases with widely spaced sutures than in others. Probably there were also other modes of spread of decidua in the surgical wounds. Decidua might have been left in the wounds on completion of the operations. Decidua passing from the uterus via the cervical canal might subsequently have been implanted in the wound in the vaginal wall. As regards these pathways of spread of decidua, however, the series appeared to be homogeneous. Such modes of origin of endometriosis could not, therefore, explain the observed differences in the incidence of that condition. The follow-up findings made it seem evident that the operative techniques had a significant bearing on the occurrence of endometriosis. Probably a technique involving closure of the uterine wall with sutures at frequent intervals, after vaginal hysterotomy, would have lessened the chances of subsequent endometriosis in the operation zone.

Endometriosis invading the urinary bladder has earlier been described as a serious complication of vaginal hysterotomy. At the first examinations in this series, two cases with such lesions were found. The danger of disturbances in the urinary tract might conceivably be less for superficial changes in the hysterotomy scar than for deeper and more extensive endometriotic lesions. These

latter were commoner in cases with long than in those with shorter follow-up times. Everett (1944), Wharton (1946), and Brosset (1954) demonstrated that a long time may elapse before vesical endometriosis gives rise to characteristic symptoms of that condition. It was desirable, therefore, to have longer follow-up periods if the danger of endometriosis involving the bladder was to be evaluated on the basis of the symptoms present. Since cystoscopy was not possible in all of the 885 patients who had, at some time, undergone vaginal hysterotomy, it could be done only in those who, when followed up 4—5 years after the operations of 1952—53, reported such urinary tract symptoms that had arisen or exacerbated since previous examinations.

In the seven patients who presented endometriosis in or contiguous to the bladder wall, a direct transition was observed between those lesions and the changes in the hysterotomy scars. In five cases the latter changes consisted of endometriosis, which condition was, in all probability, present in the other two cases too. It seemed plausible to assume, therefore, that the lesions in or adjacent to the bladder wall had resulted from vaginal hysterotomy.

The observed incidence of endometriosis in or near the bladder wall was probably lower than it should have been in fact. Previous excisions or biopsies of endometriosis in the hysterotomy scars had possibly somewhat reduced the chances of, or had delayed, endometriosis involving the urinary tract, which conceivably would have been observed at later follow ups, for example, 4—5 years after operation. As pointed out above, not all patients could be subjected to cystoscopy; nor was that examination always possible at the most apposite stage of the menstrual cycle. Pathologic changes in the urinary bladder might have been detected in a further number of cases had the examinations been performed during or immediately after menstruation. In view of the above-mentioned shortcomings, it was not unlikely that lesions involving the bladder were overlooked in a number of cases.

Only a few of the patients from whom no information could be obtained 4—5 years after the operations of 1952—53, had shown endometriosis in the hysterotomy scars at previous examination. These lesions were much commoner in the 575 patients who were possible to follow up at that time. The latter cases thus seemed to

be well representative of the total number that had undergone vaginal hysterotomy in 1952—53, with regard to the risks of endometriosis involving the urinary tract. Here it was assumed that the latter condition would have arisen from endometriosis in the hysterotomy scars. This, as mentioned in the foregoing, appeared to be the case in all of the seven patients with endometriosis involving the urinary tract. Moreover, the effects of the previous excisions or biopsies were not taken into account; see above.

Endometriosis in the hysterotomy scars or involving the bladder was observed more often in patients with longer follow-up times. Similar lesions were found at subsequent examinations in cases where they had not previously been demonstrable. It seemed probable, therefore, that endometriosis with the localizations in question would have been a more common finding if the patients had been consistently examined at an even later date after vaginal hysterotomy. The present follow ups terminated 5 years, at the latest, after the legal abortions — and in most cases earlier.

As emphasized in the account of genitourinary tract symptoms due to endometriosis that were observed at the first follow up, i. e., within 4 years after the legal abortions of 1952—53, considerable difficulties were encountered in determining the extent to which endometriosis had actually given rise to symptoms. The investigation into the incidence and extent of endometriosis had certain shortcomings. Probably the incidence of endometriosis was underestimated. In patients who had undergone more than one vaginal hysterotomy, it could not be ascertained when endometriotic lesions had arisen. From all this it is evident that no reliable idea could be gained of the extent to which observed endometriotic changes had produced symptoms. Judging by the results of the investigation, the great majority of patients with endometriosis had no symptoms of that condition when first followed up.

SUMMARY

As a result of vaginal hysterotomy, endometriosis had developed in 19.8 per cent of the 840 patients who had undergone that operation in 1952 or 1953 and, in some, on another occasion too. Endometriotic lesions were found in scars in the vaginal wall on the anterior surface of the cervix, in the anterior cervical wall or, in a few cases, in or contiguous to the bladder wall.

Such lesions occurred irrespective of the age at operation, the number of earlier pregnancies, postoperative estrogen treatment, and the duration of the interrupted pregnancies. Postoperative complications suggesting that the operation zone had possibly been exposed to increased traumatization did not demonstrably heighten the chances of endometriosis.

Endometriosis was found more often in patients with longer follow-up times.

The occurrence of endometriosis was found to be dependent on the operative technique employed. It appeared likely that closure of the uterine wound with sutures inserted at frequent intervals reduced the chances of subsequent endometriosis.

Endometriosis producing changes in the urinary bladder was found in seven of the 840 patients. It seemed highly probable that in each of these seven the lesions had resulted from vaginal hysterotomy. The changes were localized to the lower parts of the bladder and did not involve the ureteric orifices.

Endometriotic lesions may well have been overlooked in a number of cases. Hence the reported incidences of endometriosis were probably somewhat lower than the true figures. It appeared likely, moreover, that endometriosis would have been observed in a further number of cases had the follow-up periods been longer.

In the great majority of the 146 cases that presented endometriosis with the relevant localizations at the first follow up, i. e., up to 4 years after the vaginal hysterotomies of 1952—53, it had not demonstrably given rise to symptoms consisting of metrorrhagia, dysmenorrhea, obscure lower abdominal pain, or dyspareunia. Urinary tract symptoms in the form of pollakiuria or dysuria had arisen, as a result of endometriosis, in four cases.

C. PATHOLOGIC CHANGES IN THE UTERINE WALLS,
CHIEFLY IN THE ISTHMUS AND ADJACENT
PARTS OF THE CORPUS, OBSERVED
AT HYSTEOSALPINGOGRAPHY

1. *Highly Irregular Contour of the Isthmic Wall*

In five of 611 patients who had undergone vaginal hysterotomy without dilatation of the cervix, the isthmic wall was found to have highly irregular contours. This resulted in deformation of the cavity in the corresponding part of the uterus. By irregular contour is not meant changes, described below, consisting of cavities, fistulae or funnel-shaped recesses in the isthmic wall.

The above-mentioned five patients had shown uneventful postoperative courses, though one of them had a temperature exceeding 38° following the legal abortion. This patient had not had any other pregnancy or operation on the uterus. The other four were multigravidae. One of them had also previously undergone vaginal hysterotomy as well as curettage twice for incomplete abortion. None of the five had been involuntarily sterile after the legal abortions. One of them exhibited a similar irregular contour of the corporeal wall. When examined, none of these five patients had definite signs of genital tract infection.

2. *Fistulae in the Uterine Wall*

Twenty-five patients showed narrow, contrast-filled fistulae, often extending from the uterine cavity 4—5 mm or more into the uterine wall. In 24, all of whom had undergone at least one vaginal hysterotomy, the fistulae were about 1 mm in diameter and localized to the anterior isthmic wall; in the other the fistula was situated in the upper right portion of the anterior corporeal wall. The latter patient had undergone abdominal hysterotomy with the incision in the right cornu, and the postoperative course had been uneventful. She had previously had several pregnancies, and also curettage. The 24 patients who had been subjected to vaginal hysterotomy are listed in table 29. None of the patients in this table had been pregnant between the operations of 1952—53 and the follow up.

Table 29. *Factors with a possible causal relationship to fistulae in the isthmic wall, and findings on examination in cases thus affected.*

	Vaginal hysterotomy 1952—53		Abdominal hysterotomy with incision in upper part of corpus 1952—53
	Primigravida at operation	Multigravida at operation	
Total of cases of fistulae	9	12	3 ⁴
Vaginal hysterotomy on other occasion	—	4	3
Other curettage	—	2	1
Genital tract infection not due to operation in 1952—53	1	2	—
Temperature exceeding 38° or eleva- ted for more than five days following operation in 1952—53	1	—	3
Cervicitis 3 wks after operation in 1952—53	—	2	—
Other operations on uterus	1 ¹	2 ²	—
<i>Findings on examination</i>			
Cervical erosion	—	2	—
Elevated hysterotomy scar (without endometriosis)	3	2	—
Endometriosis in hysterotomy scar ..	2	3 ³	1
No other operations involving isth- mic region than vaginal hysterotomy	8	8	—
No genital tract infection and no other operations involving isthmic region than vaginal hysterotomy ..	7	6	—
Total of cases subjected to hystero- salpingography	614		81

¹ Abdominal hysterotomy with incision in upper part of corpus uteri.² In one case, operation of unknown character in anterior fornix; examination disclosed an elevated scar there and endometriosis in corresponding part of bladder wall. The other case had undergone instrumental delivery.³ In one case, endometriosis of bladder wall coinciding with an elevated hysterotomy scar in which no endometriosis was detectable.⁴ These cases had had at least one earlier pregnancy.

It will be seen that 17 patients had undergone vaginal hysterotomy only in 1952 or 1953; that 16 had not been subjected to any other operation involving the isthmic region, and that 13 of these had at no time shown signs of genital tract infection. Seven of these 13 patients had had no other pregnancy than that interrupted in 1952 or 1953. Comparatively pronounced temperature reactions and disturbances postoperatively had not been commoner in these cases with fistulae than in the others. Aside from two patients with cervical erosion, no definite signs were observed of past or present genital tract infection at the follow up. A relatively large proportion of the fistula cases had elevated hysterotomy scars or endometriosis therein.

Twelve patients who had been subjected to vaginal hysterotomy in 1952—53, but no other operation involving the isthmic region, were followed up within 2 years. As pointed out earlier, the technique employed at vaginal hysterotomy varied somewhat. In these twelve patients closure of the uterine wall with widely spaced and with closely spaced sutures had been equally common. The former mode of procedure, which probably increased the chances of subsequent endometriosis in hysterotomy scars, thus had no demonstrable relationship to these fistulae.

3. Cavities in the Isthmic Wall

Contrast filling of small rounded cavities in the isthmic wall was observed in 49 cases. Various factors that conceivably had a causal relationship to these cavities are listed in table 30. Seven of the patients had had no other pregnancy than the interrupted one.

Of the 40 patients in this table who had undergone vaginal hysterotomy in 1952—53, 13 had at some time had genital tract infection or had shown temperatures exceeding 38° or elevated for more than five days after operation. Complications or fairly pronounced temperature reactions postoperatively had not been appreciably commoner in patients with cavities than in others who had undergone similar operations. Six patients had neither had genital tract infection before the legal abortion nor any other

Table 30. *Factors with a possible causal relationship to cavities in the isthmic wall, and results of examination in cases thus affected.*

	Types of operations 1952—53			
	Dilatation of cervix and curettage	Vaginal hysterotomy	Abdominal hysterotomy	Laminaria dilatation, curettage and bilateral salpingectomy
Total of cases with cavities	2	40	5	2
Other curettage	1	11 ¹	2	—
Other hysterotomy with incision in isthmus region	1	9	—	1
Temperature exceeding 38° or elevated for more than five days following operation of 1952—53	—	5	4	2
Re-curettage at vaginal hysterotomy	—	1	—	—
Cervicitis or endometritis at examination after 3 weeks	1	5 ²	—	—
Genital tract infection during observation period	—	2	—	—
<i>Findings on examination</i>				
Cervical erosion	—	2	—	—
Salpingitis	—	2	—	—
No other measures involving isthmic region than operation 1952—53	—	22 ³	3 ⁵	1
No other operations as above and no other pregnancy	—	7 ⁴	—	—
Total of cases subjected to hysterosalpingography	25	614	114	7

¹ Including one with earlier salpingitis.² Including two with no other operation than vaginal hysterotomy.³ Including two with earlier salpingitis but uneventful postoperative courses.⁴ One case had earlier had salpingitis; another, temperature exceeding 38° following the legal abortion; a third underwent re-recurettage and had cervicitis 3 weeks after interruption of pregnancy; and a fourth showed cervical erosion when examined.⁵ Incision of corpus in all three, and enucleation of myoma in one.

pregnancy or operation than those relevant here. Twenty-six had undergone no other operations involving the isthmic region than the legal abortions of 1952—53. At the follow up, there were signs of genital tract infection in four of the 49 with cavities.

4. Funnel-shaped Recesses in the Uterine Wall

A large number of patients exhibited contrast filling of funnel-shaped recesses extending from the uterine cavity into the wall. These recesses were broad at the base and tapered off peripherally. The largest of them had their apices 4—5 mm inside the uterine wall. In two patients who had undergone abdominal hysterotomy with a fundal incision, and one of them enucleation of myoma too, the recesses were located higher up in the anterior corporeal wall. The other recesses were localized to the anterior wall in the isthmic region or in adjacent parts of the corpus. Their incidence is shown in table 31.

It will be seen that recesses were observed in 139 (27.0 per cent) of 514 patients who had undergone vaginal hysterotomy in 1952—53 but no other hysterotomy or legal abortion; and in 143 (27.2 per cent) of 525 who had been subjected to vaginal hysterotomy in 1952—53 but no other hysterotomy with the incision in the isthmic region. No recesses in the isthmic zone or adjacent part of the corpus were found in any of the 76 patients who had not undergone vaginal hysterotomy in 1952—53 or other operations with uterine incisions in the isthmic region. There was a statistically significant difference ($p \leq 0.001$) between the incidence of recesses in the above groups of 525 and 76 cases. Recesses were present in 124 of 448 patients who had undergone no other operation on the uterus than a single vaginal hysterotomy. These 124 included 48 who were gravida I at the time of the legal abortion. Forty-five of these had not been pregnant between the operation and follow up. Having regard to the above facts, it was plausible to assume that recesses in the isthmus or adjacent parts of the corpus had resulted from vaginal hysterotomy.

Table 32 shows the incidence of recesses in relation to the durations of the interrupted pregnancies. It is confined to patients who

Table 31. *Incidence of funnel-shaped recesses in lower part of uterus in relation to types of operations.*

Operative method at legal abortion in 1952—53; hysterotomies at other times	Total of cases	Number with funnel-shaped recesses
Dilatation of cervix and curettage	15	—
Dilatation of cervix and curettage; vaginal hysterotomy	10	2
Vaginal hysterotomy	514	139
Vaginal hysterotomy; further interruption of pregnancy but not hysterotomy with incision laid in isthmus	11	4
Vaginal hysterotomy; at least one other similar operation	84	32
Vaginal hysterotomy; further interruption of pregnancy, operative technique unknown, or abdominal hysterotomy with incision in isthmus (3 cases) ..	5	—
Abdominal hysterotomy with incision in fundus uteri	56	—
Abdominal hysterotomy with incision in fundus uteri; hysterotomy with incision in isthmus	25	9
Abdominal hysterotomy with incision in isthmus; possibly further hysterotomy with similar incision	33	7
Laminaria dilatation, curettage and sterilization ..	5	—
Laminaria dilatation, curettage and sterilization; vaginal hysterotomy or interruption of pregnancy by unknown means	2	—
Total	760	193

had undergone vaginal hysterotomy in 1952—53, had not since been pregnant and had not been subjected to any other interruption of pregnancy, hysterotomy or enucleation of uterine myomas.

It is evident that pregnancies with durations varying between 9 and 24 weeks did not appreciably influence the occurrence of recesses.

The incidence of recesses in relation to the number of pregnancies prior to vaginal hysterotomy in 1952—53 will be seen from table 33, comprising the same cases as those in table 32.

Table 32. *Incidence of funnel-shaped recesses in isthmic wall and contiguous part of corporeal wall in relation to duration of pregnancy in cases of vaginal hysterotomy in 1952-53.*

Duration of pregnancy	Total of cases	Cases of recesses	
		Number	%
9-12 wks	16	4	25.0
13-16 wks	198	57	28.8
17-20 wks	264	67	25.4
21-24 wks	18	6	33.3
25-28 wks	1	—	—
Total	497	134	27.0 %

Table 33. *Incidence of funnel-shaped recesses in isthmic wall and contiguous part of corporeal wall in relation to number of earlier pregnancies in cases of vaginal hysterotomy in 1952-53.*

	Total of cases	Cases of recesses	
		Number	%
Primigravidae at legal abortion in 1952-53	108	43	39.8
Multigravidae at legal abortion in 1952-53	389	91	23.4
Total	497	134	27.0 %

The difference in incidence was statistically significant ($p \leq 0.001$). Recesses were thus shown to be commoner in patients without than in those with pregnancies prior to that which had been interrupted by means of vaginal hysterotomy. The tabulated incidences were not appreciably altered by including in the analyzed series 15 patients who had pregnancies, though not interrupted ones, after the operations, and two who had undergone enucleation of myomas.

As pointed out in the foregoing, a somewhat varying technique was used for closure of the uterine wound at vaginal hysterotomy. In one group of patients who had undergone vaginal hysterotomy

in 1952—53 but no other operation on the uterus, recesses were slightly commoner after closure with widely spaced sutures than after closure with sutures at frequent intervals. However, there were substantial differences in the incidence of recesses between groups of cases in which the operative technique had been identical in the present respect but the operations had been performed by different surgeons. For this reason it could not be ascertained whether the mode of closure of the uterine wound had any causal relationship to the recesses.

These recesses varied in localization and size. In 15 cases they were localized to the lower part of the corpus; in the others to the isthmic region or the transitional zone between isthmus and corpus. Some had a width and depth of only a few millimeters; others had broad bases and depths of 4—5 mm. Of a total of 55 large recesses, 50 were situated in the isthmic region or the transitional zone.

Thirty-two patients with recesses — in 30 of them localized to the isthmus or the transitional zone between isthmus and corpus — and seven with large recesses, had full-term deliveries after the follow up. None of these patients had shown ruptures or threatened ruptures of the uterus.

Of 426 patients who had undergone vaginal hysterotomy in 1952—53 and, when subjected to hysterosalpingography during the secretory phase, showed contrast passage into the abdominal cavity through at least one normal tube, 36 had an internal os exceeding 5 mm in diameter. Seven, or 19.4 per cent, of these 36 had funnel-shaped recesses in the lower part of the uterus. In four (11.1 per cent) the recesses were localized to the isthmus and not to the transitional zone or higher. In patients with internal os diameters not exceeding 5 mm the corresponding incidences were 27.4 per cent (107 of 390 cases) and 16.7 per cent (65 of 390 cases) respectively. Recesses were thus relatively rare when the internal os diameter exceeded 5 mm, and hence had no demonstrable relationship to such anatomical changes in the uterine wall that gave rise to a relatively wide internal os. Similar results were obtained on exclusion, from the analyzed series, of those patients who were submitted to hysterosalpingography during the last two days of the cycle.

DISCUSSION

According to Schinz (1952) a highly irregular contour of the uterine wall may result from infections. In the opinion of Russian workers (*vide* Mayer, 1933; Stamer, 1946) atresia may arise in the uterus following interruptions of pregnancy. According to Stamer (1946), Hald (1949), Netter *et al.* (1956), Asherman (1957), Bergman & Wehlin (1957), and Dalsace *et al.* (1957), uterine atresia and intrauterine adhesions may follow curettage for puerperal hemorrhage or at abortion. — It was uncertain whether the highly irregular contours of the isthmic wall, observed in this series, pointed to sequelae of infections, to partial atresia or adhesions, or whether they were the direct consequences of surgical trauma. The patients otherwise showed no signs of genital tract infection, past or present. Since the exact nature of the changes was obscure, the connection between the operations of 1952—53 and these pathologic changes appeared uncertain, particularly in the four patients who had had other pregnancies or operations on the uterus.

The fistula-like changes were found only in those parts of the uterine walls where hysterotomy incisions had been made. They resembled the changes which according to Norman (1958) are typical of endometriosis. They did not fully resemble the lesions typical of endometriosis that were described by Åkerlund (1943), Erbslöh (1955, 1956), and Marshak & Eliasoph (1956); nor the changes of inflammatory origin reported by Asplund (1952), or the residue of Gartner's ducts described by Bianchi, Appli & Wilk (1952). Seven patients with fistulae had had no genital tract infection, no other operation, and no other pregnancy than that interrupted by vaginal hysterotomy in 1952—53. In these seven cases it seemed highly probable that the fistulae had resulted from the legal abortions, provided that such fistulae do arise as sequelae of trauma or infection. The previous occurrence of genital tract infections and the postoperative courses did not suggest that the fistulae were consistently of inflammatory origin. It has been mentioned elsewhere that it was often impossible to

evaluate accurately the extent of endometriosis in the hysterotomy scars. At excisions or biopsies there were frequently observed fine fistula-like offshoots which extended from the endometriotic lesions far into the uterine wall and which could not be followed throughout their courses. Such offshoots possibly communicated with the uterine cavity and became contrast-filled therefrom at the hysterosalpingographies. The occurrence of these offshoots from the endometriotic lesions might, therefore, suggest that the contrast-filled fistulae were manifestations of endometriosis in the uterine wall. Further support for this hypothesis would then lie in the fact that relatively numerous patients with fistulae had endometriosis in the hysterotomy scars, or somewhat swollen scars in which biopsy might have revealed endometriosis. Taking everything into account, it seemed most likely that the fistulae were due to endometriosis, as was suggested, too, by their localization. They were localized, moreover, to those parts of the uterine walls which had been incised at the hysterotomies.

According to Asplund (1952), changes resembling the cavities that were here observed in the isthmic wall are possibly manifestations of endometriosis following operative measures involving the isthmic region, as for example curettage and dilatation of the cervix. Twenty-six of the present cases had undergone no other operation of probable significance than the legal abortions of 1952—53. However, the majority had previously had pregnancies, though whether these had given rise to the lesions, for example at childbirth, was unknown. As regards the incidence of inflammatory conditions following the operations of 1952—53, and of other genital tract infections, the cases with cavities did not diverge appreciably from the rest of the series. Hence there was no cogent evidence that the cavities were sequelae of infections. On the assumption that they had resulted from trauma associated with surgical measures involving the isthmic region, it seemed likely that in 26 cases they were due to the operations of 1952—53. In other cases the significance of those operations was more obscure. Seven patients had had no other operation and no other pregnancy than that interrupted in 1952—53; six of them had had no genital tract infection prior to the legal abortion. Only in these six cases could it be claimed with any assurance

that the cavities were sequelae of the legal abortion; this, provided that cavities can result from trauma or infections.

The recesses in the anterior uterine wall that were observed in a large number of cases appeared to be localized to those parts which had been incised at hysterotomy. They resembled the pathologic changes described by Baker (1955). This author found the lesions in patients who had undergone cesarean section, and attributed them to scars in the uterine wall that possibly increased the chances of rupture of the uterus in connection with childbirth. Rubovits, Cooperman & Lash (1953) observed a pathologically thin cervical wall in patients with internal os insufficiency. The changes in the cervical wall were regarded as sequelae of violent dilatation of the cervix or incisions in the cervix. — Malmnäs (1957) found in one case, at childbirth, a greatly attenuated, bulging anterior uterine wall at the site of the incision made at a previous vaginal hysterotomy. On the basis of the foregoing observations and results of the examinations it seemed probable that the recesses observed in this series were due to scars in the uterine wall. Possibly these recesses could be expected to show a higher incidence in cases where there had been comparatively large incisions in the uterine wall — i.e., patients in relatively far advanced pregnancy at the time of the legal abortion — as well as in those where the uterine wound had been closed with widely spaced sutures. However, the duration of the interrupted pregnancy and the technique at vaginal hysterotomy were not found to have demonstrably influenced the relevant incidence.

Recesses were commoner in patients who were gravida I at the time of the vaginal hysterotomies. A conceivable explanation of this was that such cases presented greater technical difficulties, the uterine wall thus being subjected to increased traumatization at the legal abortions. Arén, Bergman & Eliasson (1957) considered it likely that this increased traumatization raised the incidence of premature deliveries in patients who had been gravida I when subjected to vaginal hysterotomy.

A few of Baker's (1955) patients with recesses and a number of those in the present series subsequently had pregnancies and full-term deliveries without signs of rupture or threatened rupture

of the uterus. — Several thousand women residing in Stockholm have undergone vaginal hysterotomy during the last decade. A large number who had previously undergone that operation have doubtless been delivered of children since then at the departments of obstetrics in Stockholm. Many of these patients probably had recesses in the uterine wall as a result of earlier operations. An investigation showed that none of the patients in whom uterine ruptures occurred in connection with childbirths at the departments of obstetrics in Stockholm during the period from 1947 to 1956 had previously undergone vaginal hysterotomy. In view of these findings it seemed unlikely that the recesses would appreciably heighten the danger of uterine ruptures.

SUMMARY

Five of 614 patients who had undergone vaginal hysterotomy were found to have isthmic walls with highly irregular contours. The exact nature and mode of origin of these pathologic changes were not known. In one case it seemed probable that the lesions were sequelae of vaginal hysterotomy.

Narrow fistulous tracts in those parts of the uterine wall that had been incised at hysterotomies were observed in 25 cases; they were localized to the isthmic region in 21 of the 614 patients who had undergone vaginal hysterotomy, and to the upper part of the corpus in one of 81 who had been subjected to abdominal hysterotomy with a corporeal incision, in 1952—53. The most plausible explanation was that these lesions were manifestations of endometriosis and constituted sequelae of hysterotomies — in at least 17 patients the vaginal hysterotomies of 1952—53.

Small cavities in the isthmic wall were observed in 49 patients, including 40 of 614 who had undergone vaginal hysterotomy in 1952—53. The nature of these changes was unknown. Insofar as they pointed to endometriosis resulting from traumatizing operations, it seemed probable that in at least 26 cases they were sequelae of the legal abortions performed in 1952—53. Twenty of these 26 were among the 614 patients who had undergone vaginal hysterotomy.

Funnel-shaped recesses in those parts of the uterine wall that had been incised at hysterotomies were detected in 143 of the 525 patients who had been submitted to vaginal hysterotomy in 1952—53, but no other hysterotomy with the incision in the isthmic region. They were probably due to scars in the uterine wall. They were found in 27.0 per cent of those who had undergone vaginal hysterotomy in 1952—53 but no other interruption of pregnancy. Recesses were present in the upper part of the corpus in two of 81 patients in whom corporeal incisions had been made. Recesses in the isthmic region or in adjacent parts of the corpus were found to have arisen as a result of vaginal hysterotomies in 1952—53. They were commoner in primigravidae than in the rest of the series. Neither the durations of the interrupted pregnancies nor the technique employed for closure of the uterine wounds was found to have influenced the incidence of these recesses. The latter had not demonstrably heightened the chances, of uterine rupture at childbirth. Nor did they have any appreciable bearing on such anatomical changes that had given rise to an abnormally wide internal os.

D. DIAMETER OF INTERNAL OS AND INCIDENCE OF SPONTANEOUS ABORTIONS AND PREMATURE DELIVERIES

The diameter of the internal os was evaluated with the aid of hysterosalpingography. By internal os was meant the junction between the cervix and the isthmic region or, where that site could not be localized exactly, the narrowest part of the transitional zone between cervix and corpus. Earlier workers have shown that the internal os diameter normally does not exceed 5 or 6 mm on examination during the secretory phase. It has been reported to be 3—4 mm wider during the proliferative phase than during the secretory phase, and somewhat wider during the last two days of the latter than earlier in that phase.

In this series the diameter was estimated only in cases with passage of contrast medium into the abdominal cavity through a normal tube. Included in the series were a small number of patients

with myomas, deformation of the corpus due to other causes, with polyps of the cervix or corpus, with pathologic changes in one tube, and patients who had undergone dilatation of the cervix or dilatation and curettage not associated with the legal abortions of 1952—53. None of these patients had an internal os diameter exceeding 5 mm when examined during the secretory phase; however, some patients with such diameters had previously undergone curettage for incomplete abortion, though it was unknown whether the cervix had been dilated in conjunction therewith. The point in the menstrual cycle that coincided with hysterosalpingography was calculated on the basis of findings in the endometrial biopsies that were taken, as a rule, one or two days after that examination. A number of patients were examined approximately at the time of ovulation or perhaps during the first two days of the secretory phase; in some cases endometrial biopsies could not be taken following hysterosalpingography. These patients were considered to have been examined during an indeterminate phase of the cycle.

1. Influence of Various Factors on the Internal Os Diameter

The diameter of the internal os in relation to types of operations undergone in 1952—53 will be found in table 34.

It emerges that 41 patients (9.2 per cent) had internal os diameters exceeding 5 mm on examination during the secretory phase, and that two showed diameters exceeding 10 mm when examined, respectively, during the proliferative phase and an indeterminate phase. As regards the percentages of diameters exceeding 5 mm during the secretory phase, there were certain differences between the tabulated groups in which the operative methods had differed. However, the series was too small to warrant any conclusions on the basis thereof. Of the two patients with diameters exceeding 10 mm during an indeterminate or a proliferative phase, one had a myomatous uterus and the other was later subjected to curettage during the secretory phase. The internal os then admitted a Hegar 5 dilator with slight resistance. In the first-named case uterine myomas may have been responsible for the abnormally large diameter; in the other the diameter probably did not exceed 5 mm

Table 34. Diameter of internal os in cases of passage of contrast medium into abdominal cavity through at least one normal fallopian tube.

Diameter in mm	Dilatation of cervix H. 13 and curettage				Dilatation of cervix H. 17 and curettage				Vaginal hysterotomy				Abdominal hysterotomy			
	≤ 2	$> 2 \leq 5$	$> 5 \leq 10$	> 10	≤ 2	$> 2 \leq 5$	$> 5 \leq 10$	> 10	≤ 2	$> 2 \leq 5$	$> 5 \leq 10$	> 10	≤ 2	$> 2 \leq 5$	> 5	
Proliferative phase	—	I	—	—	—	—	I	—	2	24	20	I	—	—	—	
Secretory phase ..	—	2	I	—	I	10(1)	4(2)	—	95(3)	295(25)	35(4)	I	I	I	—	
Phase of cycle in-																
determinate	—	I	—	—	—	—	—	—	8	72	22	I	—	I	—	

(Figures in parentheses refer to the number of patients examined during the last two days of the menstrual cycle.)

during the secretory phase. Patients who had undergone vaginal hysterotomy with dilatation of the cervix did not show diameters exceeding 5 mm when examined during the secretory phase.

In tables 35 and 36 will be found the internal os diameters in patients subjected to vaginal hysterotomy, tabulated in relation to the number of earlier pregnancies and to the number of previous childbirths. Cases without earlier pregnancies or deliveries conceivably presented greater technical difficulties at the legal abortions, and hence were possibly exposed to increased traumatization.

Table 35. *Diameter of internal os during secretory phase in relation to number of earlier pregnancies in cases of vaginal hysterotomy in 1952—53.*

Number of earlier pregnancies	Total of cases	Cases of internal os diameter exceeding 5 mm	
		Number	%
0	82	4	4.9
≥ 1	344	32	9.3
Total	426	36	8.5 %

Table 36. *Diameter of internal os during secretory phase in relation to number of earlier deliveries in cases of vaginal hysterotomy in 1952—53.*

Number of earlier deliveries	Total of cases	Cases of internal os diameter exceeding 5 mm	
		Number	%
0	96	4	4.2
≥ 1	330	32	9.7
Total	426	36	8.5 %

It is evident that at hysterosalpingographies during the secretory phase, internal os diameters exceeding 5 mm were not commoner in cases with no earlier pregnancies or deliveries than in the rest of the series.

Table 37 shows the internal os diameters during the secretory phase in relation to the number of vaginal hysterotomies that had been undergone.

Table 37. *Diameter of internal os during secretory phase in relation to number of vaginal hysterotomies carried out.*

	Total of cases	Cases of internal os diameter exceeding 5 mm	
		Number	%
Vaginal hysterotomy in 1952—53 only	371	32	8.6
Vaginal hysterotomy in 1952—53 and at least once more	55	4	7.3
Total	426	36	8.5 %

The table includes five patients who had each had three vaginal hysterotomies, but none of them showed diameters exceeding 5 mm.

It will be seen that diameters of over 5 mm during the secretory phase were not commoner after more than one vaginal hysterotomy than after a single operation of that type.

During the course of the interrupted pregnancies a number of patients had exhibited symptoms possibly suggestive of some disposition to spontaneous abortion. Of six patients with hemorrhage at an earlier stage of pregnancy and one with uterine hemorrhage at the time of the legal abortion, one of the first-named had an internal os diameter of 6 mm during the secretory phase, but none of the others a diameter exceeding 5 mm. On the assumption that a diameter of over 5 mm during the secretory phase suggests some disposition to spontaneous abortion, it seems not unlikely that a diameter of 6 mm had already been present before the legal abortion in the above-mentioned case.

Ten patients who were subjected to hysterosalpingography had undergone, following vaginal hysterotomy, re-suture or re-curetage for hemorrhage. In these cases the isthmic region had possibly been exposed to increased traumatization. Nine of them were

examined during the secretory phase, and one of these had a diameter exceeding 5 mm (6 mm). Since the percentage with diameters exceeding 5 mm did not differ substantially from that in the rest of the series, the relevant postoperative complication had not demonstrably increased the chances of subsequent internal os diameters of more than 5 mm. The group was too small, however, for any definite conclusion to be drawn.

Exclusion of patients examined during the last two days of the menstrual cycle did not appreciably alter the percentages of internal os diameters exceeding 5 mm that are recorded in tables 35, 36 and 37. The above-mentioned two patients with, respectively, hemorrhage during the course of the interrupted pregnancy and a complication following vaginal hysterotomy were not examined during the last two days of the menstrual cycle.

2. *Course of Pregnancies in Patients with Internal Os Diameters Exceeding 10 Mm during an Indeterminate or a Proliferative Phase and in Those with Diameters Exceeding 5 Mm during the Secretory Phase*

In the foregoing were reported two cases in which the internal os diameter exceeded 10 mm on examination during an indeterminate or a proliferative phase. One of them had uterine myomas and the other was considered to have a diameter of not more than 5 mm during the secretory phase. The former patient had no further pregnancy after the legal abortion, but the latter had a normal full-term pregnancy after the examination.

Table 38 shows the outcome of post-follow-up pregnancies in patients whose internal os diameters exceeded 5 mm during the secretory phase. In the tabulated pregnancies that reached full term, there had been no signs of threatened abortion or premature delivery. The three legal abortions had been performed in normal pregnancies of 3—5 months duration. The exact character of the "spontaneous abortions" was not known.

The table includes four patients who had undergone dilatation of the cervix to Hegar 17 and curettage. Two of them had internal os diameters of 6 mm; the other two, of 8 mm. None of these

Table 38. *Course of pregnancies after the hysterosalpingography in cases of internal os diameter exceeding 5 mm when examined during secretory phase.*

Diameter of internal os	Total of cases	Number not pregnant since hysterosalpingography	Number pregnant since hysterosalpingography and course of pregnancy			
			Full-term delivery	Premature delivery and spontaneous abortion	Legal abortion	Spontaneous abortion
6 mm ..	20 (4)	15 (4)	3 ³	—	2	—
7 mm ..	6	3	3 ⁴	—	—	—
8 mm ..	8 (1)	5 ¹ (1)	1 ⁵	—	—	2
9 mm ..	5	2	1	1 ⁶	1	—
10 mm ..	1 (1)	1 (1)	—	—	—	—
11 mm ..	1	1 ²	—	—	—	—
Total	41 (6)	27 (6)	8	1	3	2

¹ In one case a further legal abortion was performed by vaginal hysterotomy prior to the follow up.

² Criminal abortion in the interval between legal abortion and follow up.

³ One case of spontaneous abortion in the interval between legal abortion and follow up.

⁴ In one case spontaneous abortion in addition.

⁵ Subsequently, further delivery at full term.

⁶ Infected abortion in addition.

(Figures in parentheses refer to the number of patients examined during the last two days of the menstrual cycle.)

four had been pregnant after the follow up. One patient had been subjected to dilatation of the cervix to Hegar 13 and curettage; she had a diameter of 7 mm. The patient who had undergone vaginal hysterotomy both before and after the present legal abortion had a normal full-term pregnancy after the follow up. The other 36 patients in the table had undergone vaginal hysterotomy in 1952—53, prior to which there had been one spontaneous abortion in six, two spontaneous abortions in five, and a premature delivery in a twelfth case. Six of these 12 patients had internal os diameters exceeding 6 mm. One with an earlier spontaneous abortion was examined during the last two days of the menstrual

cycle. Judging from these data, 12 of the 41 tabulated cases had possibly had some disposition to spontaneous abortion or premature delivery before the legal abortions of 1952—53.

It is evident from the table that eight patients with internal os diameters of up to 9 mm had normal full-term pregnancies after the follow up. A few of the tabulated patients had undergone further operations or criminal abortions between the legal abortions of 1952—53 and the follow up. Whether these measures had affected the internal os diameter was not clear.

3. Diameter of Internal Os in Patients with Involuntary Sterility

Fertility in Patients with Internal Os Diameters not Exceeding Two Millimeters

Previous authors have expressed the view that spasm of the internal os, or possibly a narrow and rigid os, may impair the fertility. Of five patients in this series who were involuntarily sterile after the operations of 1952—53, four were subjected to hysterosalpingography. Three of them had internal os diameters of between 2 and 5 mm during the secretory phase, though in one there was no contrast filling of the tubes; and the fourth, who was examined during an indeterminate phase, had a diameter of between 5 and 10 mm. Of the 107 tabulated patients with internal os diameters not exceeding 2 mm, 37 (34.6 per cent) had pregnancies after the legal abortions of 1952—53, and in most cases after the hysterosalpingographies. Thus there was no evidence that the fertility was appreciably impaired in patients whose internal os diameters did not exceed 2 mm.

4. Incidence of Spontaneous Abortions and Premature Deliveries after the Operations of 1952—53

In patients who had undergone legal abortions in 1952—53 by the methods of dilatation of the cervix and curettage, or vaginal hysterotomy, the incidence of spontaneous abortions had been 8.9 per cent (165 of 1,854 pregnancies) prior to those operations, and 9.3 per cent (16 of 172 pregnancies) between them and the first

follow up. Women in whom the pregnancies had been interrupted by other methods had had no spontaneous abortions since the operations.

Judging by the above incidences the legal abortions had not resulted in any appreciably increased disposition to spontaneous abortion.

The series was too small to show if any such increased disposition had followed the operations consisting of dilatation of the cervix and curettage. The incidence of spontaneous abortions in patients who underwent vaginal hysterotomy in 1952—53 will be seen from table 39.

Table 39. *Incidence of spontaneous abortions in cases of legal abortion by vaginal hysterotomy in 1952—53.*

	Total of pregnancies	Spontaneous abortions	
		Number	%
Before legal abortion	1,739	154	8.9
Between legal abortion and follow up	164	14	8.5
After follow up	268	36	13.4

There was no statistically significant difference in the tabulated incidences. Similar results were obtained on statistical analysis of series comprising all pregnancies that were not interrupted or only intrauterine pregnancies that terminated spontaneously. The vaginal hysterotomies of 1952—53 accordingly were not found to have caused any increased tendency to spontaneous abortion.

Pregnancies with known courses after the operations of 1952—53 totalled 452. In 53 of them (11.7 per cent) there were spontaneous abortions.

The data on the incidence and course of pregnancies occurring after the first investigation comprising the entire series were procured at subsequent examinations and follow ups. In the course of the investigation it emerged that each of six patients had two possibly spontaneous abortions after the operations of 1952—53. These six had undergone vaginal hysterotomy. Some of them

had had the first spontaneous abortion before the clinical examination; the remainder, after it.

It was originally intended to perform hysterosalpingography in all patients who had had no full-term pregnancies after the operations of 1952—53. Patients subjected to that examination had not had such pregnancies, and accordingly were to some extent selected. The same applied to those who had been successful in their efforts to avoid pregnancy and who refused to undergo hysterosalpingography; a number of them became pregnant after the clinical examination. The course of these pregnancies is shown in table 40.

Table 40. *Course of pregnancies after follow up in cases not examined by hysterosalpingagraphy and not pregnant between legal abortion and follow up.*

Full-term delivery	23
Premature delivery	1
Spontaneous abortion	3
Criminal abortion	1
Legal abortion	11
Course unknown	2
Total	41

In the series tabulated there, spontaneous abortions amounted to 7.7 per cent of all pregnancies with known courses. In the rest of the series the corresponding incidence was 12.1 per cent for pregnancies after the operations of 1952—53. Hence there was no reason to assume that internal os insufficiency producing an increased disposition to spontaneous abortion was commoner in patients who had had no pregnancy between the operation and follow up and had not undergone hysterosalpingography, than in the others.

Patients subjected to vaginal hysterotomy in 1952—53 had, during the next few years, a total of 259 childbirths the courses of which could be studied. Ten of these (3.9 per cent) were premature deliveries. Three patients with twin pregnancies and parturition before term were not included in premature deliveries

above. If these three cases be included as premature deliveries, the incidence of the latter will amount to 5 per cent of all childbirths after the vaginal hysterotomies of 1952—53. Patients who had undergone other types of operations in 1952—53 did not have premature deliveries thereafter.

Of the 25 patients who had undergone vaginal hysterotomy in 1952—53 and, between that operation and the follow up, had had one spontaneous abortion or, after the operation, premature deliveries or two possibly spontaneous abortions, one had been subjected to re-suture of the vaginal wall following the legal abortion. In the other 24 there had been no re-curettage or re-suture. Spontaneous abortions or premature deliveries thus could hardly be attributed to those surgical measures.

5. Course of Other Pregnancies in Patients with Spontaneous Abortions or Premature Deliveries after the Operations of 1952—53, and the Influence of Various Factors on their Incidences

a. Number and Course of Pregnancies Prior to those Interrupted in 1952—53

Of the ten premature deliveries occurring after the legal abortions of 1952—53 — in each case vaginal hysterotomy — one was in a patient with a history of two spontaneous abortions prior to that operation. Another patient with a premature delivery had had one spontaneous abortion but no other pregnancy prior to the interrupted one. Seven premature deliveries occurred in patients who had had at least one pregnancy at term prior to the legal abortion. The incidence of premature deliveries after the operations of 1952—53 in relation to the number of pregnancies before those that were interrupted will be found in table 41.

Three patients with twin pregnancies and parturition before term were not included in premature deliveries above. Each of them had had at least one full-term pregnancy before that which was interrupted, in each case by vaginal hysterotomy. None of them underwent hysterosalpingography.

Table 41. *Incidence of premature deliveries after vaginal hysterotomy in 1952—53, in relation to number of pregnancies prior to that operation.*

Number of pregnancies prior to legal abortion in 1952—53	Number of full-term or premature deliveries	Premature deliveries	
		Number	%
0	55	2	3.6
≥ 1	204	8	3.9
Total	259	10	3.9

Of the 16 patients with spontaneous abortions between the interrupted pregnancies of 1952—53 and follow up, two had had no pregnancy prior to the legal abortions; thirteen had had at least one full-term pregnancy. There had been spontaneous abortions in four of these 16 before the operations of 1952—53. The incidence of spontaneous abortions in patients who underwent vaginal hysterotomy in 1952—53, in relation to the number of pregnancies before those that were interrupted, is shown in table 42.

Table 42. *Incidence of spontaneous abortions between legal abortion and follow up, in relation to number of earlier pregnancies in cases of vaginal hysterotomy in 1952—53.*

Number of pregnancies prior to legal abortion in 1952—53	Total of interuterine pregnancies between legal abortion and follow up	Spontaneous abortions between legal abortion and follow up	
		Number	%
0	20	1	5.0 %
≥ 1	144	13	9.0 %
Total	164	14	8.5 %

In each of the six patients who had two possibly spontaneous abortions after the operations of 1952—53, there had been at least one full-term pregnancy prior thereto.

It is evident from the foregoing that the majority of those with premature deliveries after the operations of 1952—53, most of

those with spontaneous abortions between the operations and the follow up, and all of those with two possibly spontaneous abortions after the operations, had had full-term pregnancies before the interrupted ones. The incidence of spontaneous abortions between operation and follow up, and that of premature deliveries after the operations, were not higher in patients without than in those with pregnancies before the ones that were interrupted by vaginal hysterotomy. A number of patients had had spontaneous abortions or premature deliveries both before and after the legal abortions of 1952—53.

b. Diameter of Internal Os and Course of Subsequent Pregnancies

The ten premature deliveries were referable to nine patients, six of whom underwent hysterosalpingography. In five the internal os diameter did not exceed 5 mm; one of these had two premature deliveries and one a full-term pregnancy later on. In the sixth case the internal os had a diameter of 9 mm during the secretory phase; this patient also had two possibly spontaneous abortions after the operation of 1952 or 1953. In the above-mentioned patient with two premature deliveries, there had been premature separation of the normally situated placenta on each occasion, the second one also being associated with toxemia of pregnancy. Of the three patients who did not undergo hysterosalpingography, one subsequently had a full-term pregnancy.

The 16 cases with spontaneous abortions between the operation and follow up are listed in table 43. Aside from one patient, with an internal os diameter not exceeding 5 mm, who had been subjected to vaginal hysterotomy and who said the abortion had occurred in the fourth or fifth month, the probable times had been in the first trimester.

Of the six patients with two possibly spontaneous abortions after vaginal hysterotomy in 1952—53, four had internal os diameters not exceeding 5 mm; of the two others with diameters exceeding 5 but not 10 mm, one had been examined during an indeterminate phase of the cycle and the other during the secretory

Table 43. *Diameter of internal os and course of pregnancies occurring after the follow up in cases of spontaneous abortion between the legal abortion in 1952—53 and the follow up.*

	Total of cases	Diameter of internal os		Number of cases of later pregnancies and their course			
		≤ 5 mm	$> 5 \leq 10$ mm	Spontaneous abortion	Legal abortion	Full-term delivery	No pregnancy
Hysterosalpingography during indeterminate phase	2	1	1	1	—	—	1
Hysterosalpingography during secretory phase (but not on last 2 days of menstrual cycle) ..	8	7	1 ¹	—	2	5 ²	1
No hysterosalpingography ..	6	—	—	—	1	3	2

¹ Spontaneous abortion before the legal abortion; full-term delivery after the follow up.

² Including one case in which the internal os was 6 mm wide and two cases of spontaneous abortion before full-term delivery.

phase. The last-named patient also had a premature delivery after the legal abortion, and has therefore been included in the above cases with premature deliveries. She had a history of two spontaneous abortions prior to the interrupted pregnancy. Two of the other five patients with two possibly spontaneous abortions after the operation, subsequently had full-term pregnancies.

It emerges from the foregoing that an internal os diameter exceeding 5 mm during the secretory phase was observed in one patient with a spontaneous abortion between the interrupted pregnancy and follow up, and in another with both a premature delivery and possibly spontaneous abortions after the follow up. However, each of these patients had conceivably had some disposition to spontaneous abortion before the operations of 1952—53. In other patients who underwent hysterosalpingography, the internal os

diameter did not exceed 5 mm on examination during the secretory phase. Numerous patients with spontaneous abortions or premature deliveries after the operations of 1952—53 subsequently had full-term pregnancies.

c. Other Pathologic Changes

Hysterosalpingography and endometrial biopsy were performed in ten cases with spontaneous abortions between the interrupted pregnancy and follow up, in six with premature deliveries, and in six with two possibly spontaneous abortions after the operations of 1952—53.

One patient who had undergone curettage for incomplete abortion between the interrupted pregnancy and follow up showed, at hysterosalpingography, septum-like changes in the uterine cavity. Curettage was done two days later, nothing noteworthy being observed in the uterus. This patient had a normal pregnancy after the examination.

In one patient with two spontaneous abortions, one of them before the investigation, hysterosalpingography showed, in the posterior wall of the corpus, a moderate and circular depression with a diameter of about 1.5 cm. She had undergone no other operation than vaginal hysterotomy, and had a full-term pregnancy after the follow up.

At hysterosalpingography, funnel-shaped recesses were observed in the uterine wall in four of nine patients with spontaneous abortions between vaginal hysterotomy and follow up, in one of six with two possibly spontaneous abortions and in one of six with premature deliveries. Four recesses were situated in the isthmic wall. Three patients with recesses had normal intrauterine pregnancies after the follow up.

In other respects these cases presented nothing worthy of note at the examination.

It was very uncertain whether the septum-like changes had resulted from vaginal hysterotomy, since the patient had undergone another operation on the uterus between the legal abortion and follow up. Judging by the results of other examinations and

the outcome of the subsequent pregnancy, the changes were of no major significance. The nature of the large depression in the uterine wall was obscure, and likewise its mode of origin and clinical significance. Funnel-shaped recesses in the uterine wall were relatively common in patients who had had spontaneous abortions between the operations of 1952—53 and follow up. Whether these abnormalities pointed to anatomical changes associated with internal os insufficiency and a disposition to spontaneous abortion was not clear, the group being too small to permit any conclusions.

It is evident from the investigation that no pathologic changes were observed that had a definite causal relationship to spontaneous abortions or premature deliveries and were thought to constitute sequelae of the legal abortions. Here the aforementioned observations on the diameters of the internal os were not taken into account.

DISCUSSION

Asplund (1952) described cyclic changes of the internal os diameter observed at hysterosalpingography in patients with sterility, dysmenorrhea or disturbances of menstruation. Westman (1955) reported the occurrence of a functional sphincter with cyclic changes of tonus in the isthmic region, corresponding to the observations made by Asplund (1952). According to the latter author (1952, 1954) the internal os diameter normally does not exceed 5 to 6 mm at hysterosalpingographic examination during the secretory phase. Youssef (1958) observed reduced tonus in the isthmus during the last two days of the cycle, though he did not state the degree to which it influenced the internal os diameter, evaluated from hysterosalpingograms. His observation was not, therefore, taken into consideration here when calculating the percentage of internal os diameters exceeding 5—6 mm during the secretory phase.

Asplund (1952) relatively often found an abnormally wide internal os in patients who had had repeated spontaneous abortions, and a narrow one in those who had suffered from uterine infections. The association between a wide internal os and a disposition

to spontaneous abortion was also pointed out by Palmer & Lacomme (1948), Palmer (1950), Lash & Lash (1950), Asplund (1954), d'Ernst (1956), Jeffcoate & Wilson (1956), Green-Armytage & McClure-Brown (1957), Lash (1957), and Youssef (1958). Lash & Lash (1950), Asplund (1952), Rubovits, Cooperman & Lash (1953) and Bergman & Genell (1957) observed an abnormally wide internal os, producing a tendency to abortion in women who had undergone surgical measures involving the relevant part of the uterus, such as violent dilatation of the cervix and vaginal hysterotomy. Rubovits, Cooperman & Lash (1953) detected, at operations, anatomical changes of the uterine wall in the isthmic region which they ascribed to previous dilatation of or incisions in the cervix. Changes there were described by Baker (1955) in patients who had been subjected to abdominal cesarean section with hysterotomy in the isthmic zone. Russian workers (*vide* Mayer, 1933; Stamer, 1946) had found stenosed areas in the uterus which they attributed to legal abortions.

Asplund (1952) pointed out that uterine infections might contribute to stenosis of the internal os. — The extent to which such inflammatory conditions had been present in this series could not be ascertained, owing to the incomplete information furnished by the patients with regard to previous diseases. The internal os diameters prior to the operations of 1952—53 were unknown. However, numerous patients in whom the internal os was, according to the norms of earlier authors, abnormally wide had previously had one or two spontaneous abortions or premature deliveries; and one had had hemorrhages during an earlier phase of the subsequently interrupted pregnancy. Possibly these patients had already had, before the operations of 1952—53, an abnormally wide internal os manifesting as a disposition to spontaneous abortion or premature delivery. In a few cases there had been, between the legal abortions and follow up, operations on the uterus which had involved the internal os; but their effect on the latter's diameter was unknown. Eight of 41 patients with an "abnormally" wide internal os had full-term pregnancies after the investigation. — Jeffcoate & Wilson (1956) and Wilson (1957) reported patients in whom, apart from an "abnormally"

wide internal os, there were no signs of any disposition to spontaneous abortion or premature delivery and who later had normal pregnancies. According to Jeffcoate & Wilson (1956) the functional state of the internal os possibly varies from one pregnancy to another, for reasons unknown. — Asplund (1952) showed that the internal os may undergo slight distention during hysterosalpingography. — The present hysterosalpingographies were performed without concurrent measurement of the intrauterine pressure to which the contrast medium was subject. In view of the considerations enumerated above, it was difficult to ascertain in what degree the observations on the diameter of the internal os were criteria of damage caused by the operations of 1952—53. It was also difficult to evaluate the clinical significance of the "abnormally" wide internal os that was observed in a number of cases.

Asplund (1952) suggested that a stenosed, rigid internal os might cause sterility. According to Robins & Shapira (1931) and Dalsace (1943), spasm of the internal os may impair the fertility. In the present series a narrow internal os with a diameter not exceeding 2 mm, did not seem to have appreciably affected the fertility, since many of the relevant patients became pregnant after the legal abortions and had not been involuntarily sterile. Here, too, shortcomings in the method of examination must be taken into account; no measurements of intrauterine pressure were done in connection with the hysterosalpingographies. It seemed uncertain, therefore, if an internal os diameter not exceeding 2 mm pointed to spasm, to a rigid, stenosed os, or to the deficiencies in the method of examination.

No increased tendency to spontaneous abortion had demonstrably arisen as a result of the legal abortions. The same experience was reported, in patients who had undergone similar operations, by Kuder & Finn (1945), Holtz (1950), Kolonja & Ulm (1952), Ekblad (1955), and Arén, Bergman & Eliasson (1957). Olsen (1950) found a high incidence of spontaneous abortion in a small series; and Engel (1953) also observed an increased tendency to abortion, though the patients in his series had usually undergone pronounced dilatation of the cervix at interruption of pregnancy. Russian workers

too (*vide* Mayer, 1933) had noted a similar tendency following legal abortions.

The incidence of premature deliveries in this series did not exceed that reported by Arén, Bergman & Eliasson (1957) in an obstetrical series. Earlier authors such as Svanberg (1949), Olsen (1950) and Arén, Bergman & Eliasson (1957) either found it probable or showed that an increased incidence of premature deliveries followed interrupted pregnancies. According to the last-named authors, this higher incidence applied notably to women who had been primigravidae when subjected to vaginal hysterotomy. A corresponding finding was not demonstrable in the present series. This was too small, however, for any definite conclusion to be drawn.

A number of patients had had spontaneous abortions both before and after the operations of 1952—53. Possibly, therefore, some disposition to abortion or premature delivery had already existed before those operations, so that the role of the latter in that respect seemed somewhat doubtful. Some patients with spontaneous abortions or premature deliveries, subsequently had full-term pregnancies. In these cases there could scarcely have been any major tendency to abortion or premature delivery.

Patients with spontaneous abortions between the operations and follow up, and those with premature deliveries or more than one possibly spontaneous abortion after the follow up, presented as a rule an internal os diameter not exceeding 5 mm during the secretory phase insofar as they underwent hysterosalpingography. Both patients with diameters of more than 5 mm during the secretory phase had had spontaneous abortions before the operations of 1952—53 or had full-term pregnancies after the follow up. Hence there was no definite evidence that the above-mentioned spontaneous abortions or premature deliveries occurring after the operations of 1952—53 were attributable to internal os insufficiency following those operations.

Greenhill (1958) pointed out that internal os insufficiency is relatively uncommon in cases of spontaneous abortion. A similar view was advanced by Barter, Dusbabek, Riva & Parks (1958). According to these authors, abortions during the second trimester are comparatively rare. However, internal os insuffi-

ciency is possibly of major significance when they do occur. Indeed, d'Ernst (1956) and Lash (1957) considered that it gives rise to spontaneous abortion chiefly during the second trimester. — The aforementioned authors' opinions, too, suggested that the spontaneous abortions occurring between the operations of 1952—53 and the follow up were not due in any major degree to internal os insufficiency, since in 15 of the 16 cases they were reported to have occurred in earlier stages of pregnancy.

In evaluating the extent to which the "spontaneous" abortions after the interruptions of pregnancy actually had been spontaneous, it must be borne in mind that the great majority of patients in this group had sought to avoid pregnancy after those operations; that further pregnancy was often regarded as something of a disaster; and that it was a fairly general belief that another legal abortion would not be granted. It accordingly seemed probable — although it could not be shown — that a number of "spontaneous" abortions had in fact been criminal. In particular the reports on abortions occurring after the clinical examinations were regarded as unreliable, since most of them were based solely on written questionnaires or data from the case records of other hospitals. With the exception of those patients who had two possibly spontaneous abortions after the operations of 1952—53, no investigation was made, therefore, into such factors that conceivably had a bearing on "spontaneous" abortions after the clinical examinations. In the six patients who had two possibly spontaneous abortions, a disposition to abortion was considered to be somewhat more likely.

SUMMARY

Of 446 patients subjected to hysterosalpingography during the secretory phase and showing passage of contrast medium into the abdominal cavity through at least one normal tube, 41 (9.2 per cent) had an internal os diameter exceeding 5 mm, in 21 of whom it was more than 6 mm. Diameters exceeding 5 mm were found in 8.5 per cent of 426 patients who had undergone vaginal hysterotomy, and in 27.8 per cent of 18 who had been subjected to dilata-

tion of the cervix and curettage and examined under the above conditions.

The connection between the legal abortions and internal os diameters exceeding 5 mm, and the clinical significance of the above observations on the internal os, were in many cases obscure.

Repeated vaginal hysterotomies and complications following them which possibly caused increased traumatization of the uterus had not demonstrably heightened the chances of internal os diameters exceeding 5 mm.

Such diameters were not commoner in patients without than in those with histories of pregnancy prior to that interrupted by vaginal hysterotomy in 1952 or 1953.

Internal os diameters of more than 5 mm were found in a few patients with abortions or premature deliveries after the operations of 1952—53, but it was not certain if the latter had any causal relationship thereto.

A narrow internal os with a diameter not exceeding 2 mm could not be shown to have reduced the fertility.

In the series as a whole the legal abortions had not demonstrably resulted in any increased disposition to spontaneous abortion or premature delivery.

Abortions and premature deliveries were not commoner in patients without than in those with histories of pregnancy before that which was interrupted by vaginal hysterotomy in 1952 or 1953.

The probability seemed remote that the legal abortions had given rise, in more than a few cases, to such lesions as to produce internal os insufficiency and hence an increased tendency to spontaneous abortion or premature delivery.

E. PATHOLOGIC CHANGES IN THE CORPUS UTERI

1. *Findings on Gynecologic Examination*

Atrophy of the uterus was found in one patient, who had undergone abdominal hysterotomy and bilateral resection of the tubes, with an uneventful postoperative course. Later on there had been amenorrhea of long duration, though uterine bleeding occurred

a few times after treatment with estrogens. An attempt at endometrial biopsy failed to yield any specimens. In the other cases no changes were observed that appeared to be sequelae of the operations of 1952—53.

2. *Findings on Hysterosalpingography*

Fistulae and funnel-shaped recesses in the corporeal wall have been reported in the foregoing.

In seven of 614 patients, all of whom had undergone vaginal hysterotomy in 1952—53, the corporeal part of the uterine cavity showed a highly irregular contour. In all save one of them, whose temperature had exceeded 38° , the postoperative course had been uneventful. Three weeks later, one of them had endometritis. She also presented that condition when followed up, and in the meantime had undergone bilateral salpingectomy for salpingitis which had already been present before the legal abortion. Another patient, too, had salpingitis both before the operation and when followed up. Of the remaining five, one had had an infected abortion, one curettage for metrorrhagia, and a third curettage for incomplete abortion between the interrupted pregnancy and follow up. The last-named case was among those with the most pronounced changes. Following the examination she was subjected to curettage and, shortly afterwards, had a normal intrauterine pregnancy. Of the other two patients, who showed less pronounced changes, one had had two previous pregnancies and the second no pregnancy before or after the legal abortion; nor any operation on the uterus other than vaginal hysterotomy in 1952 or 1953. This woman, who showed a postoperative temperature exceeding 38° , also had a highly irregular contour of the uterine cavity in the isthmic region. None of these seven patients had been involuntarily sterile after the interruptions of pregnancy. Aside from the above-mentioned findings, they showed no pathologic changes in the uterus or adnexa at the follow up, which also comprised curettage or endometrial biopsy.

In one patient who had undergone vaginal hysterotomy, a circular depression with a diameter of about 1.5 cm was observed

in the posterior wall of the corpus. She had previously had a normal childbirth and, between the interruption of pregnancy and follow up, a spontaneous abortion. After the follow up, she had first what was probably a spontaneous abortion and thereafter a normal delivery at term.

In another case, also of vaginal hysterotomy, there was a depression the size of a hempseed in the posterior wall of the corpus. This patient had previously had a normal childbirth and curettage for incomplete abortion.

Intravasal contrast filling was observed in three cases. One of them had undergone vaginal hysterotomy; the other two abdominal hysterotomy and bilateral resection of the tubes. In the first-named case there was only incomplete contrast filling of one tube and no filling of the other. Microscopic examination disclosed normal endometrium in each of the three patients. One of them was subjected to curettage for metrorrhagia in connection with the examination; she had already undergone the same procedure for that condition between the operation and follow up, and had then had endometritis. In all three the course had been uneventful following the operations of 1952—53.

3. *Findings on Endometrial Biopsy*

This section does not include the results of examinations for the presence of ovulation.

Endometrial biopsies were taken in 747 cases, which are set forth in table 49 on page 132. With regard to the types of operations that had been undergone, these cases were relatively representative of the total series. In most patients only small biopsy specimens were obtained; thus the examinations possibly yielded inadequate information on the endometrium.

One patient who had been subjected to vaginal hysterotomy in 1952—53 underwent a further interruption of pregnancy and sterilization before the follow up, at which she had a somewhat irregular endometrium in the proliferative phase. In another who had undergone vaginal hysterotomy, biopsy revealed endometrium that possibly was slightly hyperplastic. She had a normal preg-

nancy after the examination. — Insofar as the lesions had been due to the operations of 1952—53, they had not demonstrably affected the fertility, since both patients became pregnant thereafter.

Polyps involving the corpus were found in two patients, one of whom had undergone vaginal hysterotomy and the other abdominal hysterotomy and bilateral resection of the tubes. Since most cases were subjected only to endometrial biopsy and not complete curettage at the follow up, no conclusions could be drawn from the observed incidence of polyps. It was uncertain, moreover, if the latter had resulted from the operations. The postoperative courses had been uneventful.

Nonspecific endometritis was present in six patients, five of whom had undergone vaginal hysterotomy and the other abdominal hysterotomy and resection of both tubes. In each case the postoperative course had been uneventful, though when examined three weeks after operation one patient had endometritis and one cervicitis. However, the first of these two had suffered repeatedly from salpingitis before the legal abortion and, after the latter, had undergone bilateral salpingectomy for that condition; the other had had operations for extrauterine pregnancy and for cervical myoma before the follow up. At hysterosalpingography in this case, there was no contrast filling of the single remaining tube, the reason being unknown. A third patient underwent curettage in connection with the follow up, and thereafter had a normal pregnancy. She and the last preceding case were examined 3—4 years after the legal abortions. In a fourth case there had been gonorrhea between the operation and follow up.

DISCUSSION

In the patient with an abnormally small uterus, the condition seemed more likely to have been due to the protracted amenorrhea than to the operation itself. As will be pointed out later on in the report on ovarian function, the amenorrhea may have resulted from the operation.

Russian workers (*vide* Mayer, 1933; Stamer, 1946), as well as Stamer (1946), Hald (1949), Netter *et al.* (1956), Asherman (1957), Dalsace *et al.* (1957), and Bergman & Wehlin (1957) observed more or less pronounced adhesions or atresia of the uterine cavity in patients who had undergone interruptions of pregnancy or curettage for puerperal hemorrhage or hemorrhage associated with incomplete abortion. According to Asherman (1957), intrauterine adhesions do not, as a rule, cause sterility. In the opinion of Schinz (1952), endometritis may give rise to abnormalities in the contour of the uterine cavity similar to those found in the present series. Here the postoperative courses in 1952—53 did not suggest that the observed irregularities in contour were consistently the results of genital tract infections following the relevant operations. Six of the seven cases had had pregnancies or operations or infections that were not demonstrably connected with the legal abortions of 1952—53; only in one case was there a reasonable likelihood of a causal relationship between the latter and the uterine wall irregularities.

It seemed uncertain if the changes were due to adhesions. Following hysterosalpingography all patients, except one who underwent complete curettage, were subjected to exploration of the uterine cavity and endometrial biopsy. Since nothing noteworthy was observed in the cavities, there could scarcely have been any fixed or extensive adhesions.

Moreover, the changes had not demonstrably affected the fertility to any major degree, for no patient had been involuntarily sterile and, indeed, one of them with the most pronounced changes later had a normal pregnancy.

Having regard to the foregoing remarks, it appeared that the legal abortions may have given rise only in exceptional cases to fairly marked irregularities in the contour of the corpus uteri walls. Both the nature of these changes and their significance from the standpoint of fertility seemed uncertain.

The exact character and significance of the depressions in the posterior uterine wall in two cases were unknown. The smaller depression resembled those changes which Åkerlund (1943), Erbslöh (1955, 1956), and Marshak & Eliasoph (1956) reported to be typical of endometriosis. — Insofar as the latter

condition was present, it was not unlikely to have resulted from previous curettage for incomplete abortion. There was no definite evidence that the operations of 1952—53 had any bearing on these changes. The larger of the two depressions was possibly due to a diverticulum. Diverticula in pregnant women were mentioned by De Lee & Greenhill (1947) and reported by Jarvis (1951), Rubovits (1953) and Pierce (1958). Their etiology was unknown. — In view of the above considerations, the depressions in these two cases could hardly be attributed with assurance to the legal abortions of 1952—53.

The cause of the intravasal contrast filling in three cases was unknown. None of these showed contrast passage through the tubes, and the intrauterine pressure to which the radiopaque medium was subject was not known. According to observations made by Shanks & Kerley (1950), Schinz (1952) and Zachariae (1955), a high intrauterine pressure may have been responsible for the intravasal contrast filling. On the other hand, Kayser (1951) and Kik a (1954) pointed out that the phenomenon was usually due to inflammatory lesions of the endometrium — according to the latter author, generally of tuberculous etiology. Garzon (1956), reported, in part, similar observations. — At these examinations there was no other evidence, however, of tubercular changes. None of the patients exhibited endometritis or had had inflammatory complications following the operations of 1952—53. According to Drukman & Rozin (1951), intravasal contrast filling may occur under otherwise normal conditions; according to Zachariae (1955), it may arise from congenital anomalies of the endometrium. — Taking all these factors into account, the intravasal filling in the present cases could not plausibly be ascribed to pathologic changes in the uterine wall arising from the legal abortions of 1952—53.

In Russian investigations (*vide* Mayer, 1933), damage to the endometrium such as destruction or impaired regeneration was not uncommon as a result of induced abortions. In this series there were no pathologic changes that could be attributed with any assurance to direct lesions of the endometrium following the legal abortions.

It was very doubtful if the operations of 1952—53 had, in most cases, any causal relationship to endometritis. Four of the six patients had shown uneventful courses after the legal abortions. All cases with endometritis were subjected to curettage or endometrial biopsy one or two days after hysterosalpingography. Whether that examination had given rise to endometrial lesions was uncertain. Some patients had had genital tract infections prior to the legal abortions or later, without any relationship thereto. Such infections producing no appreciable clinical symptoms and not connected with the operations had possibly arisen during the follow-up period, which in some cases was relatively long.

SUMMARY

The legal abortions of 1952—53 were apparently associated with only a slight risk of pathologic changes in the corpus uteri, excluding the fistulae and funnel-shaped recesses described earlier. Atrophy of the uterus was found in one case. It was probably due to amenorrhea, which in turn was possibly a sequela of abdominal hysterotomy and bilateral resection of the tubes. A highly irregular contour of the uterine wall in the corpus had probably arisen in one, and possibly in a further six of 760 cases. Endometritis was observed in six of 747 cases, though whether it had resulted from the legal abortions of 1952—53 or not seemed uncertain.

F. PATHOLOGIC CHANGES IN THE FALLOPIAN TUBES

The state of the tubes was evaluated on the basis of clinical findings, the occurrence of pregnancies after the legal abortions of 1952—53, and the results of hysterosalpingographies. The latter examinations were not undertaken in patients who, on clinical examination, had been found to be pregnant, nor, as a rule, in those who had had intrauterine pregnancies between the legal abortions and follow up. The roentgenologic appearance of the tubes prior

to the interrupted pregnancies was unknown. At hysterosalpingography, therefore, contrast filling of only one tube was often considered sufficient when both tubes did not fill relatively swiftly. As a rule the aim was to obtain contrast passage into the abdominal cavity. In a number of cases, however, lesser amounts of contrast medium were used and the examination was discontinued at an earlier stage. This was possibly the reason why some patients showed no complete contrast filling of either tube or no contrast passage into the abdominal cavity. The term "contrast passage" implies, in the following, passage of contrast medium through a tube or tubes into the abdominal cavity.

The clinical examination yielded no reliable information on the presence of such tubal changes that had resulted from the operations of 1952—53, over and above that obtained by means of hysterosalpingography or on the basis of anamnestic data. At the clinical examinations salpingitis had been detected in one case, and the diagnosis was verified by hysterosalpingography. Of the 15 patients who showed a fixed uterus or marked tenderness outside the uterus, 12 were subjected to hysterosalpingography and the remaining three had intrauterine pregnancies after the legal abortions. Two of these latter three had suffered from salpingitis after the last-named pregnancies.

1. Results of Hysterosalpingographies and Incidence of Intrauterine Pregnancies after the Legal Abortions of 1952—53

Hysterosalpingography, as will be discussed later on, sometimes yielded relatively meager data on the state of the tubes. Detailed in table 44, however, are the results of the hysterosalpingographies and the incidence of intrauterine pregnancies after the legal abortions. Such pregnancies were not investigated in patients who, at hysterosalpingography, had exhibited two normal tubes and contrast passage through at least one of them.

The 250 tabulated cases in which hysterosalpingography was not performed, included 10 patients who had undergone sterilizing operations on the tubes between the legal abortions and follow up;

Table 44. *Findings at hysterosalpingography and occurrence (Hysterosalpingography performed*

Appearance of the fallopian tubes at hysterosalpingography	Vaginal hysterotomy		Vaginal hysterotomy with dilatation of cervix	
	Total of cases	Number of cases of intra- uterine preg- nancy	Total of cases	Number of cases of intra- uterine preg- nancy
Tubes normal and patent	455	?	1	?
Tubes normal; one tube patent	51	?	—	—
One tube normal and patent; incomplete or no filling of the other	60	18	2	—
Both tubes patent; one tube normal; in- flammatory changes in the other	1	—	—	—
One tube normal and patent; inflamma- tory changes in the other and no contrast passage ¹	6	2	—	—
Normal tubes but no contrast passage ..	1	1	—	—
One tube normal but no contrast passage; incomplete filling of the other	4	2	—	—
One tube normal but no contrast passage; no filling of the other	2	2	—	—
One tube normal; inflammatory changes in the other; no contrast passage	2	—	—	—
Incomplete filling of both tubes; no contrast passage	1	1	—	—
Incomplete filling of one tube; no filling of the other	3 ²	1	—	—
No filling of the tubes	11	5	—	—
Inflammatory changes in both tubes; both tubes patent	1	—	—	—
Inflammatory changes in both tubes; one tube patent	1	—	—	—
Hysterosalpingography not performed ..	234	160	1	1

¹ Contrast passage = passage of contrast medium into the peritoneal cavity.² In one case of twin pregnancy (one extra- and the other intrauterine) operation for the extrauterine pregnancy during the earlier course of the intrauterine pregnancy interrupted later. At operation both tubes showed pathologic changes: one was excised, the other resected.

*of intrauterine pregnancies after legal abortion in 1952—53.
in 631 of the total of 881 cases).*

Dilatation of cervix H. 13 and curettage		Dilatation of cervix H. 17 and curettage		Abdominal hysterotomy		All hysterosalpingo- graphies	
Total of cases	Number of cases of intra- uterine preg- nancy	Total of cases	Number of cases of intra- uterine preg- nancy	Total of cases	Number of cases of intra- uterine preg- nancy	Total of cases	Number of cases of intra- uterine preg- nancy
4	?	13	?	3	?	476	?
—	—	2	?	—	—	53	?
1	—	1	—	—	—	64	18
—	—	—	—	—	—	1	—
—	—	—	—	—	—	6	2
—	—	1	1	—	—	2	2
—	—	—	—	—	—	4	2
—	—	1	—	—	—	3	2
—	—	—	—	—	—	2	—
—	—	1	1	—	—	2	2
—	—	—	—	—	—	3	1
—	—	1	1	1	—	13	6
—	—	—	—	—	—	1	—
—	—	—	—	—	—	1	—
8	3	7	4	—	—	—	—

in five of them this sterilization had been done in conjunction with further legal abortions. At the sterilizing operations, performed via laparotomy, no pathologic changes were observed in the pelvic organs. In these 10 patients hystero-grams were taken. This notwithstanding, they were excluded from the tabulated cases examined by that means, since the state of the tubes could not be evaluated with the aid of hysterosalpingography, and there was no reason to assume that the tubes had been damaged as a result of the operations of 1952—53. Of the aforementioned 250 patients, 168 had intrauterine pregnancies after the legal abortions of 1952—53. The patient in table 44 who, at operation for extrauterine pregnancy during the subsequently interrupted pregnancy, had shown pathologic changes in both tubes, probably had a greatly impaired tubal function at the time of the legal abortion. This case was accordingly discarded when calculating the incidence of impaired tubal function due to the legal abortions. Of the remaining 630 patients, 10 (1.6 per cent) had had no intrauterine pregnancy after the operations of 1952—53 and showed no normal tube at hysterosalpingography. Nine of these 10 had undergone vaginal hysterotomy and one abdominal hysterotomy with enucleation of a myoma in 1952—53. Eighty-two patients had neither been pregnant since the legal abortions nor had been subjected to hysterosalpingography. They had not shown any pathologic conditions in the tubes that required surgical measures, between the legal abortions and follow up. The same applied to 168 patients who were not submitted to hysterosalpingography but had become pregnant after the legal abortions of 1952—53.

Of the above-mentioned 10 patients, three had undergone bilateral salpingectomy for salpingitis before the follow up, and two had bilateral salpingitis. One of the remaining five showed only very slight contrast filling of the tubes; the other four none at all. One of these patients underwent hysterosalpingography twice; in another case five fruitless attempts were made to obtain contrast filling of the tubes. The latter patient was finally subjected to laparotomy. On insufflation of gas, no passage was found through the grossly normal tubes. Thereafter, resection was done of the interstitial part of one tube and the adjacent part of the isthmus tubae; the contralateral tube was not operated on. Microscopic

examination of the resection specimen disclosed sclerosed tubal tissue with a lumen obliterated by connective tissue. Both tubes were considered to be occluded as a result of salpingitis. — Another patient without contrast filling of the tubes had undergone unilateral salpingectomy for tubal pregnancy, as well as enucleation of a cervical myoma between the legal abortion and follow up. In this case and the remaining three with no satisfactory contrast filling of either tube at hysterosalpingography, the reason for this result was not known. Of the total of 10 patients who showed no normal tube at hysterosalpingography and had had no intrauterine pregnancies between the legal abortions and follow up, the hysterosalpingographic findings were accordingly considered to be due to salpingitis in six cases, while in four there was no satisfactory filling of either tube, for reasons unknown.

All patients who had neither been pregnant after the legal abortions nor had undergone hysterosalpingography, had sought to avoid further pregnancy.

A total of five patients had been involuntarily sterile for more than one year after the legal abortions. One of them subsequently had a normal pregnancy; the other four were subjected to hysterosalpingography. Three of these had normal, patent tubes; the fourth showed no contrast filling of the tubes, due, it was thought, to bilateral salpingitis. Sterility due to organic changes in the tubes was thus present in one of five patients who had been involuntarily sterile for a considerable time after the legal abortion.

2. *Causal Significance of Various Factors in Inflammatory Changes Observed in the Tubes at Hysterosalpingography*

It will be seen from table 44 that inflammatory changes of at least one tube were observed in 11 cases. Five of these patients had been hospitalized for salpingitis prior to the legal abortions, and two others had had gonorrhea. The two patients with bilateral tubal lesions had had, respectively, salpingitis and gonorrhea before the interrupted pregnancies; in each of them at least one tube was patent. Of the remaining four patients, two had earlier under-

gone operations for tubal pregnancy and ovarian cyst respectively; a third had had a previous legal abortion and an instrumental delivery; and the fourth had been involuntarily sterile for at least 10 years. The pregnancy that was interrupted in 1952 or 1953, as well as a subsequent intrauterine pregnancy, had arisen from relations with other partners; hence the earlier sterility had possibly been due to the partner at that time, though he was not available for examination. Each of the two patients who had had no previous genital tract infection and had not undergone operations on the tubes or ovaries, showed one normal tube with contrast passage.

None of the 11 patients had exhibited any complications directly after the legal abortions; in four of them the temperature had not exceeded 37.5° and in the others 38° ; all of them were afebrile within five days after the operations. When examined three weeks postoperatively they had shown no appreciable disease, aside from one case with cervicitis. This patient, who had previously been sterile for more than 10 years, subsequently had an intrauterine pregnancy, like one of the patients who had suffered from salpingitis before the legal abortion.

The investigation showed that 10 of the 11 patients had earlier had genital tract infections or operations on the genital organs and had shown uneventful courses after the legal abortions of 1952—53; while the remaining patient — the only one with any form of complication following the interruption of pregnancy — later became pregnant and hence had not had demonstrably impaired fertility as a result of the legal abortion. — Having regard to the above findings, and since nothing was known about the roentgenologic appearance of the tubes before the operations of 1952—53, it was uncertain whether these latter had given rise to the tubal lesions in any of the 11 cases.

3. *Significance of Various Factors Relative to Unsatisfactory Contrast Filling of One or Both Tubes or Absence of Contrast Passage into the Abdominal Cavity at Hysterosalpingography*

It is evident from table 44 that in 91 cases there was no satisfactory contrast filling of one or both tubes or no contrast passage at hysterosalpingography. In some cases this was possibly due, as pointed out earlier, to the injection of insufficient amounts of contrast medium. On the other hand, the possibility could not be precluded that the relevant findings were attributable to organic lesions arising from the legal abortions. Some earlier workers claim to have shown that contrast filling of the tubes is easiest to obtain if hysterosalpingography coincides with the time of ovulation. In the following are discussed various factors that possibly influenced the results of hysterosalpingography in the pertinent cases.

a. *Cases with contrast passage through one normal tube and incomplete or no filling of the other*

It will be seen from table 44 that this particular finding was recorded in 64 cases. Two of these patients had undergone dilatation of the cervix and curettage, with uneventful postoperative courses and temperatures not exceeding 38° . They had had no salpingitis or operations on the adnexa. The remaining 62 had undergone vaginal hysterotomy. All of these 64 cases are set forth in table 45.

It will be observed that 14 patients had possibly, before the legal abortions, shown pathologic changes in a tube or had undergone operations for pathologic conditions in the adnexa. Comparison with the results of examination, reported later on, in patients with complications or with temperatures exceeding 38° or elevated for more than five days after the operations of 1952—53, shows that the above-mentioned disturbances were not appreci-

Table 45. *Factors possibly concerned in unsatisfactory filling of one fallopian tube at hysterosalpingography.*

Previous salpingitis and operation on adnexa	4
Previous salpingitis; no operation on adnexa	5
Previous operation on adnexa; no salpingitis	5
Temperature exceeding 38° or elevated for more than 5 days following legal abortion	11 ¹
Complication associated with legal abortion	1 ²
<i>Findings on examination 3 weeks after legal abortion</i>	
Salpingitis or parametritis	2
Cervicitis or endometritis	6
<i>Hysterosalpingography</i>	
At time of ovulation	4
Not at time of ovulation	54
At indeterminate phase of cycle	6
Total of cases 64 ³	

¹ Including 4 cases of intrauterine pregnancy after legal abortion in 1952—53.

² Case of previous salpingitis; after the legal abortion re-curettage and salpingitis.

³ Including 18 cases of intrauterine pregnancy after the legal abortion in 1952—53.

ably commoner in the cases listed in table 45 than in others subjected to hysterosalpingography. At least 54 of the 64 patients were not examined at ovulation time.

b. Cases with partial or complete contrast filling of at least one tube but no contrast passage into the abdominal cavity

Fourteen cases from table 44 that showed more or less complete contrast filling of at least one tube but no contrast passage, are listed in table 46.

From table 46 it emerges that all the patients with signs of complications following the legal abortions, later had intrauterine

Table 46. Factors that possibly influenced the findings on examination in cases of complete or partial contrast filling of one or both fallopian tubes; no passage of contrast medium into the abdominal cavity.

	Total of cases	No intrauterine pregnancy after legal abortion; number of cases	Intrauterine pregnancy after legal abortion; number of cases
Salpingitis prior to legal abortion ..	2	1 ¹	1
Operations on both tubes during course of pregnancy, before inter- ruption	1	1	—
Temperature exceeding 38° or elevat- ed for more than 5 days following legal abortion	2	—	2
Cervicitis, endometritis 3 weeks after legal abortion	1	—	1
<i>Hysterosalpingography</i>			
At time of ovulation	2	—	2
Not at time of ovulation	11	4	7
At indeterminate phase of cycle	1	1	—
Total of cases	14	5	9

¹ Considerable leakage of contrast medium into vagina; complete contrast filling of one tube.

pregnancies. In two cases incomplete contrast filling may have been due to factors not attributable to the legal abortions. Eleven of the 14 patients were not examined at ovulation time.

c. Cases without Contrast Filling of the Tubes

Of the 13 patients in table 44 who showed no contrast filling of the tubes, six had intrauterine pregnancies after the operations of 1952—53. One of these six had shown a postoperative temperature exceeding 38°; otherwise the postoperative courses had been uneventful and the findings negative at examinations after three weeks. None of them were examined at ovulation time, and

none of them had had any known adnexal disease prior to the operations of 1952—53.

Of the seven who had not become pregnant after those operations, three had undergone bilateral salpingectomy for salpingitis between the legal abortions and follow up. Prior to the interruption of pregnancy, one of these had received medical treatment for repeated attacks of salpingitis, and the other two had been hospitalized for salpingitis. One of these two had suffered repeatedly from that disease, which was also present at the time of the legal abortion; the other had repeatedly had gonorrhea. In the former there had been obscure abdominal pain following the legal abortion; otherwise all three patients had shown uneventful postoperative courses and had not had temperatures exceeding 38° . When examined three weeks after the legal abortion, one patient showed salpingitis and another endometritis. — In these three cases it seemed unlikely that the changes which had indicated bilateral salpingectomy were due in their entirety to the legal abortions; rather, earlier salpingitis had been aggravated as a result of the latter. A fourth case that showed no contrast filling of the tubes was the aforementioned patient who underwent hysterosalpingography, was subjected to laparotomy, and was considered to have bilateral salpingitis producing occlusion of the tubes. This patient had shown an uneventful course following the legal abortion and no appreciable disease on examination three weeks thereafter. Since she had had no known genital tract infection (except cervical erosion prior to the legal abortion) and had undergone no previous operation on the tubes or ovaries, it seemed most likely that the tubal abnormalities had resulted from the legal abortion — vaginal hysterotomy.

In the remaining three patients, who had not been pregnant after the legal abortions, the cause of the lack of contrast filling was unknown. One of these three had undergone abdominal hysterotomy and enucleation of a myoma; the other two vaginal hysterotomy. In all three the postoperative temperatures had exceeded 38° but, aside from one in whom cervicitis was found three weeks after vaginal hysterotomy, the postoperative courses had otherwise been uneventful. The patient with cervicitis had subsequently undergone unilateral salpingectomy for tubal preg-

nancy and, later on, enucleation of a cervical myoma. Endometritis was found at the follow up. The second patient, who had undergone vaginal hysterotomy, had shown salpingitis prior thereto and was twice subjected to hysterosalpingography — once at an unknown phase of the menstrual cycle and once during the secretory phase. The other two were not examined at ovulation time.

It emerges from the foregoing that several different factors may have influenced the results of the hysterosalpingographies. A number of patients had possibly suffered from pathologic conditions in the adnexa before the legal abortions. Information on such conditions was obtained, however, chiefly from the patients themselves and hence was somewhat unreliable. The technique employed at hysterosalpingography has already been described, and possibly influenced the results thereof. At least 73 of the 91 patients were examined at what was possibly an unsuitable point in the menstrual cycle, i.e., a point not coinciding with ovulation time. Although complications or elevated temperatures had occurred postoperatively in some cases, they had not been much commoner in these 91 than in the others that underwent hysterosalpingography. Hence there was no evidence that the incomplete contrast filling necessarily pointed to tubal lesions which had resulted from the legal abortions. Of the 88 patients who had not undergone bilateral salpingectomy for salpingitis before the follow up, 33 had intrauterine pregnancies after the legal abortions and thus evidenced a relatively intact tubal function. Only in five of the 91 cases was it certain or fairly probable that the lack of contrast filling was due to organic changes which had arisen from or been aggravated by the legal abortions of 1952—53. One of these patients had salpingitis, probably as a result of the interrupted pregnancy. Another showed, for reasons unknown, no contrast filling of the single remaining tube and had been operated on for tubal pregnancy between the legal abortion and follow up. The remaining three patients had undergone bilateral salpingectomy for salpingitis between the legal abortion and follow up.

4. *State of the Tubes in Patients with Genital Tract Infections Prior to, and in Those with Complications Following, the Legal Abortions*

Tables 47 and 48 show the results of hysterosalpingographies and the incidence of intrauterine pregnancies in patients who had had salpingitis before the legal abortions, in others who had shown inflammatory conditions of the genital organs during the course of the interrupted pregnancy, and in those with disturbances following the operations or when examined three weeks thereafter. Two patients with salpingitis during the course of the interrupted pregnancy (see earlier report of the series) were among those who had suffered from that condition prior thereto. One patient operated on for tubal pregnancy during the course of the interrupted one — she thus had a twin pregnancy — was excluded from the table. At laparotomy before the legal abortion, she was found to have pathologic changes in both tubes. Following the latter operation the course was uneventful.

Postoperative temperatures exceeding 38° or elevated for more than five days had been recorded in 112 of the 837 patients who underwent vaginal hysterotomy and in 10 who underwent other types of legal abortions in 1952—53. These 10, and 89 of the aforementioned 112, were subjected to hysterosalpingography.

The following findings emerged from the investigation. In patients who had not suffered from salpingitis before the legal abortions, it appeared that disturbances during the course of the interrupted pregnancies, postoperative complications, and inflammatory conditions observed three weeks after the operations, had no demonstrable bearing on subsequent organic changes or functional disturbances in the tubes; though possibly with the exception of a few cases. One patient with cervical erosion thus had salpingitis at the follow up, and in a few cases, including one of tubal pregnancy between the legal abortion and follow up, there was no satisfactory contrast filling of the tubes, for reasons unknown. The more pronounced postoperative elevations of temperature did not seem to have been attributable to complications with a definite causal relationship to pathologic changes or

Table 47. Findings at hysterosalpingography and incidence of intrauterine pregnancies after legal abortion in 1952-53: (1) cases of salpingitis prior to those operations, (2) cases of inflammatory processes in genital organs during course of pregnancy prior to interruption, (3) cases of immediate complications.

Appearance of the tubes at hystero-salpingography	Salpingitis before legal abortion	Inflammatory processes during pregnancy		Temp. >38° or elevated for more than 5 days following operation	Complications associated with the legal abortion						
		Gonorrhea	Colpitis, erosion, fluor		Re-suture, re-curettage	Major hemorrhage during operation	Salpingitis	Endometritis	Obscure abdominal pain	Incomplete abortion	Hematoma of vagina or parametrium
Tubes normal; contrast passage*	34	4	10	81	9	4	2	—	9	4	3
One tube normal and contrast passage; incomplete or no filling of the other ..	9	—	1	11	15	—	15	—	15	—	—
One tube normal but no contrast passage; incomplete or no filling of the other ..	2	—	—	13	—	—	—	—	—	—	—
Uni- or bilateral salpingitis	5	—	—	—	—	—	—	—	—	—	—
Incomplete or no filling of tubes	4 ¹	—	2 ²	6 ⁴	—	—	—	—	2 ⁶	—	—
Intrauterine pregnancy; hysterosalpingo-graphy not performed	10	1	1	16	—	1	1	3	1	—	—
No hysterosalpingography; no pregnancy	5	—	—	7	2	—	—	—	—	1	—
Total	69	5	14	122	12	5	4	3	13	5	3

* Contrast passage = passage of contrast medium into the abdominal cavity.

1 Including 3 cases of bilateral salpingectomy for salpingitis before the follow up.

2 One case of bilateral inflammatory changes found at the follow up; the other subsequently had an intrauterine pregnancy.

3 Subsequent intrauterine pregnancy.

4 Including three cases of subsequent intrauterine pregnancies.

5 Salpingitis prior to the legal abortion.

6 One patient had had intrauterine pregnancy before the follow up; the other had undergone bilateral salpingectomy prior to the follow up, and had salpingitis before and at the legal abortion.

Table 48. *Findings at hysterosalpingography and occurrence of intrauterine pregnancies after legal abortion in 1952—53, in cases of inflammatory processes found at examination 3 weeks after operation.*

	Findings 3 weeks after operation		
	Salpingitis, parametritis	Cervicitis	Endometritis
Normal, patent tubes	10	41	6
One tube normal and patent; incomplete or no filling of the other	2 ¹	7	—
Uni- or bilateral salpingitis	—	1 ³	—
Incomplete or no filling of the tubes	1 ²	1 ⁴	2 ^{2, 3}
Intrauterine pregnancy; no hysterosalpingography	3	13	2
No intrauterine pregnancy; no hysterosalpingography	—	5	1
Total	16	68	11

¹ Salpingitis before the legal abortion.

² One case of bilateral salpingectomy on account of salpingitis before the follow up (salpingitis also present before the legal abortion).

³ One case of intrauterine pregnancy after the legal abortion.

⁴ Operated on on account of extrauterine pregnancy and cervical myoma between legal abortion and follow up.

functional disturbances in the tubes. None of the 15 patients who underwent bilateral salpingectomy for salpingitis between the legal abortion and follow up, or who had salpingitis at the latter, had shown any appreciably elevated temperature following the interruption of pregnancy. It was not known, however, if organic lesions were present in the tubes in those cases that did not show satisfactory contrast filling. As pointed out earlier, there was no evidence that this was invariably the case. The relationship of the legal abortions to inflammatory changes in the tubes seemed doubtful in those patients who had already had salpingitis before the interrupted pregnancies.

5. *Other Pathologic Changes Observed in the Tubes at Hysterosalpingography*

In two patients, aged between 20 and 30, who had undergone vaginal hysterotomy with uneventful postoperative courses and were followed up 3—4 years thereafter, pathologic changes were observed resembling those which, according to earlier authors, pointed to endometriosis of the tubes. The changes were localized to the interstitial parts of the tubes. In neither case were there any other demonstrable changes in the tubes, both of which were contrast filled and patent.

One of the two had not had any other pregnancy or any other operation on the genital organs. The tubal changes were bilateral, and there was concomitant endometritis. The other patient had previously had a childbirth and spontaneous abortions; she had gonorrhea and was subjected to curettage for metrorrhagia between the legal abortion and follow up. The tubal changes were unilateral. At the follow up, endometriosis was found in the hysterotomy scar. — Neither of the patients had been involuntarily sterile since the legal abortions; the first of them had one, the other two, intrauterine pregnancies after the follow up. Hence the changes had not caused any major impairment of the fertility.

6. *Incidence of Extrauterine Pregnancies after the Legal Abortions*

There were two cases of extrauterine pregnancy, in each of them tubal, after the operations of 1952—53 — in both cases vaginal hysterotomy. After the operation, one of these two first had a normal intrauterine pregnancy, then an extrauterine pregnancy. This patient, who had shown an uneventful course after the interrupted pregnancy and had no demonstrable pathologic changes when examined after three weeks, was not subjected to hysterosalpingography. She also had an intrauterine pregnancy after the legal abortion. The latter had not, therefore, demonstrably impaired the tubal function. The second one has been reported earlier as a case without contrast filling of the tubes at

hysterosalpingography. Between the legal abortion and follow up, she underwent unilateral salpingectomy for tubal pregnancy, as well as enucleation of a cervical myoma. At the first operation the remaining tube showed no gross pathologic changes.

Following the legal abortions of 1952—53 there had been 452 pregnancies, of which two (0.44 per cent) were extrauterine. The corresponding incidence before those operations in the original series was 0.30 per cent. Here the pregnancies interrupted in 1952—53 were not included. The series was too small for any conclusion as to whether the legal abortions had caused an increased incidence of extrauterine pregnancies.

DISCUSSION

With the exception of the patient who had a tubal pregnancy and underwent an operation on both tubes, and possibly those patients with genital tract infections during the course of the interrupted pregnancy, there was probably a relatively satisfactory tubal function, from the standpoint of fertility, at the time of the legal abortions. A number of patients claimed to have had salpingitis, or had undergone operations on the adnexa, prior thereto. Otherwise nothing was known as to the state of the tubes before the legal abortions. Hence it could not be shown that the latter had given rise to lesions of the tubes in those patients who later had intrauterine pregnancies or who showed one normal tube at hysterosalpingography.

As pointed out in the description of the hysterosalpingographic technique, it was not always sought to obtain contrast filling of both tubes; in some cases the examination was discontinued before there had been any contrast passage into the abdominal cavity, and in other cases before there was satisfactory filling of either tube. For this reason an anatomically normal tube was considered to be present in patients who did not show contrast passage from an otherwise satisfactorily filled tube of normal appearance.

Four patients who had not undergone bilateral salpingectomy exhibited no satisfactory contrast filling of either tube; nor had

there been any intrauterine pregnancy after the legal abortions. The cause of the defective contrast filling was obscure. Both in these four cases and in numerous others with unsatisfactory contrast filling of one or both tubes, it was not impossible that temporary contraction of the tubes had been responsible. According to experience reported by Ostry (1957), many of these cases may in fact have had normal tubes. As a rule they underwent hysterosalpingography during the secretory phase; only a few patients with unsatisfactory contrast filling of the tubes had been examined at ovulation time. According to observations made by Hunter, Henry & Civin (1956), satisfactory filling might have been obtained had the examination been performed at a more apposite phase of the menstrual cycle.

Of the six patients who had undergone bilateral salpingectomy for salpingitis before the follow up, or who were considered to have bilateral salpingitis at the latter, five had suffered from genital tract infections prior to the legal abortions of 1952—53. These five could, of course, have become pregnant before the pregnancies that were interrupted, but at the follow up they presented such changes in the tubes that the fertility must have been greatly impaired, insofar as sterility had not arisen. It seemed not unlikely, therefore, that the operations of 1952—53 had aggravated the condition of the tubes, even though two of the five patients showed contrast passage at hysterosalpingography. Only in the sixth case did it appear that salpingitis, probably bilateral, had been due entirely to the legal abortion, despite the fact that the course thereafter had been quite uneventful. Although there was no conclusive evidence that bilateral changes were present in this case, the results of the examination did strongly suggest that this was indeed so. From the findings reported it would seem that inflammatory changes in the tubes chiefly affected patients who had possibly had such lesions before the legal abortions. In most cases it was very uncertain, therefore, whether the latter had any causal relationship to these changes.

Similar investigations of large series with the use of hysterosalpingography do not appear to have been conducted earlier for a study of complications following legal abortions. Reports concerning salpingitis were based as a rule on findings at clinical

examination or on information obtained from the patients themselves. The observed incidence of salpingitis resulting from the interruptions of pregnancy in 1952 or 1953 seemed to be lower in this than in many previously reported series, even though the present investigation was probably far more detailed. Reliable conclusions could scarcely be drawn from the Russian investigations reviewed by Mayer (1933), which comprised large series. These Russian workers as well as Levit (1929) had observed a higher incidence of extrauterine pregnancies in patients who had undergone legal abortions. In the latter author's opinion, mild tubal infections were not infrequently present in cases with apparently uneventful postoperative courses.

The changes observed, in two cases, in the interstitial parts of the tubes resembled those which Philipp & Huber (1939) and Madsen (1943) regarded as manifestations of endometriosis. There was no means of ascertaining if these changes had resulted from the legal abortions. Kleine (1955), on histopathologic examination, had found endometriosis of the tubes in 11 per cent of the cases examined. No data were available on the incidence of such lesions observed at hysterosalpingography in general series.

Eighty-two patients, as pointed out, had neither become pregnant nor had undergone hysterosalpingography after the legal abortions. Whether the latter had given rise to tubal lesions could not be judged in these cases. The same applied to the patient who had undergone an operation for extrauterine pregnancy during the course of the interrupted pregnancy, since she had probably had severe lesions in the single remaining tube at the time of the legal abortion. A total of 83 cases were therefore regarded as unexamined with regard to the presence of such tubal lesions that were wholly or in part sequelae of the legal abortions. Previous salpingitis, and disturbances following the interrupted pregnancies, in these 83 cases did not suggest that they differed substantially from the rest of the series, with respect to fresh or aggravated inflammatory changes in the tubes as a result of the legal abortions in 1952—53. In these respects, therefore, the other cases probably were relatively representative of the total series.

SUMMARY

With the aim of elucidating the incidence of tubal lesions resulting from the legal abortions of 1952—53, hysterosalpingography was performed in 630 of 881 cases. Of the remaining 251 patients, 168 had intrauterine pregnancies after those operations. Ten (1.6 per cent) of the 630 showed, with a varying measure of probability, tubal abnormalities that were due, wholly or in part, to the legal abortions. In four of these ten there was, for reasons unknown, little or no contrast filling of the tubes at hysterosalpingography; the remaining six were considered to have bilateral salpingitis. Three or four of the latter cases had bilateral tubal lesions producing sterility. In three of the patients with the last-named changes, and in a further two of the above-mentioned six with bilateral salpingitis, it appeared not unlikely that the legal abortions had served to aggravate pre-existing inflammatory conditions in the tubes.

Inflammatory lesions of the tubes or sequelae thereof were observed in 15 of the above 630 cases that underwent hysterosalpingography but, with few exceptions, only in patients who had possibly had salpingitis before the legal abortions of 1952—53. Only in one patient who was considered to have bilateral inflammatory changes producing sterility did those lesions appear to have been due entirely to the legal abortion. In the 251 cases that were not subjected to hysterosalpingography, there were no demonstrable inflammatory conditions in the tubes that could be attributed with assurance to the operations of 1952—53. Involuntary sterility due to tubal lesions that had probably resulted from legal abortion was found in one case. This patient, one of the aforementioned 15 cases with salpingitis, probably had bilateral involvement.

Endometriosis-like changes in the interstitial parts of the tubes were observed in two cases. These lesions had not demonstrably arisen from the legal abortions or appreciably impaired the fertility.

Inflammatory conditions in the vagina or cervix during the course of the interrupted pregnancies or at the time of the legal abortions, postoperative complications and fairly pronounced

elevations of temperature, and inflammation involving the genital organs three weeks after the operations, were not found to have had any major causal relationship to persistent salpingitis. In a few patients with genital tract infections on examination three weeks postoperatively, the legal abortions had possibly aggravated pre-existing salpingitis.

G. PATHOLOGIC CHANGES IN THE OVARIES

1. *Anatomical Changes*

Of 837 patients who had undergone vaginal hysterotomy with or without dilatation of the cervix in 1952—53, six showed, at the clinical examination, up to eggsized cystic ovaries; at laparotomy two others were found to have dermoid cysts and one a follicular cyst the size of a small orange. Between the legal abortions and follow up, three more patients had undergone operations for ovarian cysts; one of them had endometriosis of the ovary, one a corpus luteum cyst, and the third a cyst of unknown type. In the two first-named cases nothing was known as to the ovarian function between the legal abortions and the latter operations. Whether these had affected that function was unknown. Of 121 patients who had been subjected to abdominal hysterotomy and sterilization, three had a slightly enlarged cystic ovary at the clinical examination. Otherwise no anatomical changes were found in the ovaries. All of the above-mentioned 15 patients with ovarian cysts had had uneventful postoperative courses and were found to have ovulated since the operations of 1952—53. Those of them who did not show endometrium in the secretory phase at biopsy, had been pregnant after the above-mentioned operations. Hence they had not demonstrably acquired such ovarian changes as to disturb the function and thus to inhibit the ovulatory process.

2. *Disorders of Function*

The ovarian function was evaluated from the results of endometrial biopsies and from the incidence of pregnancies after the legal abortions of 1952—53. Ovulation was considered to have occurred in patients who had been pregnant after those operations and in cases where biopsy showed secretory endometrium.

Table 49 shows the extent to which endometrial biopsies were performed, the findings of endometrium in the secretory phase, and the incidence of pregnancies after the operations of 1952—53 in cases without secretory endometrium at biopsy and in those where biopsies were impracticable. The tabulated cases include five patients with involuntary sterility of long duration after the operations of 1952—53. In each of these five, ovulation had occurred since those operations, because four of them had endometrium in the secretory phase and the fifth subsequently became pregnant.

Judging by the table, those patients whose ovarian function could be studied were relatively representative of the total series with respect to the types of legal abortions undergone in 1952—53. Endometrial biopsies were taken in 747 cases. A total of 40 did not show endometrium in the secretory phase. Thirty-five of these had endometrium in the ordinary proliferative phase; one, glandular hyperplasia with slight signs of glandular cystic hyperplasia; one, endometrium without signs of cyclic activity; one, hypoplastic endometrium with slight signs of proliferation; and in two cases no evaluable specimens were obtained. One of the two last-named patients had undergone radiologic castration before the follow up; the other had had amenorrhea of long duration, but previously regular menstrual bleeding had occurred following treatment with estrogens. The first of these two had been subjected to vaginal hysterotomy; the second to abdominal hysterotomy and resection of both tubes. — It will be seen from the table that nearly one half of the 40 patients had become pregnant after the operations of 1952—53. With few exceptions, these pregnancies had occurred after the biopsies. In some of these cases complete curettage had been performed in connection with the follow up.

Table 49. *Findings in endometrial biopsies and occurrence of pregnancies after the legal abortions in 1952-53.*

Operative method	Secre- tory phase	Biopsy taken; secre- tory phase not shown		No endometrial biopsy taken		Total
		Preg- nancy	No preg- nancy	Preg- nancy	No preg- nancy	
Dilatation of cervix H. 13 and curettage ..	5	—	—	3	5	13
Dilatation of cervix H. 17 and curettage ..	17	—	2	5	3	27
Vaginal hysterotomy with or without dilata- tion of cervix	568	19	16	164	70	837
Abdominal hysterotomy	4	—	—	—	—	4
Abdominal hysterotomy and sterilization	105	—	3	—	13	121
Laminaria dilatation, curettage and steriliza- tion	7	—	—	—	—	7
Dilatation of cervix H. 13, curettage and sterilization	—	—	—	—	1	1
Vaginal hysterotomy and sterilization	1	—	—	—	2	3
Total	707	19	21	172	94	1,013

Endometrial biopsies were sometimes taken relatively long before the next subsequent menstruations. The dates given by the patients for the last preceding and next subsequent menstruations were frequently unreliable; in several cases the times of the last-named menstruations could not be ascertained. This applied, for instance, to 12 of the 40 patients who showed no secretory endometrium. In six of these 40, biopsies had been taken more than 17 days before the onset of a menstruation. In three patients who had regular 28—30 day cycles, the time of biopsy was calculated from the onset of the last preceding menstruation; in the other three, from the onset of the next subsequent menstruation. A seventh patient had undergone a further legal abortion and radio-

logic castration prior to the follow up. These seven patients, all of whom had undergone vaginal hysterotomy in 1952—53, were excluded when calculating the incidence of anovulatory cycles. The remaining 740, included in table 49, were considered to have been examined with respect to the occurrence of anovulatory cycles. These latter were found in 4.8 per cent of patients who had undergone legal abortions alone, in 2.6 per cent of those subjected to legal abortions and sterilization, and in 4.5 per cent of all 740 cases. This calculation included all cases without demonstrable secretory endometrium where, so far as was known, biopsies had been taken within 16 days before the next subsequent menstruation. In at least nine of these patients the biopsies had been performed more than 10 days before the onset of the next subsequent menstruation, the time of which was known. If these nine patients were considered not to have been examined with respect to the occurrence of anovulatory cycles, there remained 731 who had undergone such examinations. In these the incidence of anovulatory cycles amounted to 3.3 per cent; in those who had undergone legal abortions alone, it was 3.4 per cent.

Anovulatory cycles were found in all age groups and in patients in whom the durations of the interrupted pregnancies had varied between 9 and 24 weeks. Some percentual differences in the incidence of anovulatory cycles existed between different groups of cases. As pointed out earlier, the exact points in the menstrual cycle at which endometrial biopsies had been taken were often unknown. Hence it was frequently difficult to judge whether anovulatory cycles had in fact been present. Only a small number of cases showed anovulatory cycles. Detailed analysis with regard to the significance of the above-mentioned factors in anovulatory cycles was accordingly impracticable.

Aside from two patients in whom satisfactory investigation was not possible, ovulation was shown to have occurred after the operations of 1952—53 in all cases where there had been immediate postoperative complications involving the genital organs.

Table 50 shows the incidence of anovulatory cycles in relation to the durations of postoperative amenorrhea. The data on these durations were often obtained some considerable time — in numerous cases, up to a few years — after the legal abortions. In many

cases, therefore, they were likely to have been somewhat unreliable.

It will be seen from the table that the ovarian function was studied in most cases with prolonged postoperative amenorrhea. The latter's duration exceeded three months in a total of 12 cases (1.2 per cent). Studies of the ovarian function were practicable in 11

Table 50. *Occurrence of anovulatory cycles in relation to duration of postoperative amenorrhea.*

Interval between legal abortion and menstruation	Secretory phase	Biopsy taken; secretory phase not shown	No endometrial biopsy taken during the last 16 days before menstruation	Total
≤ 2 months	661	30	260	951
2—3 months	38	1	11 ¹	50
3—6 months	8	1	2 ²	11
6—12 months	—	1	—	1
Total	707	33	273	1,013

¹ Including four cases subsequently pregnant and two sterilized in connection with legal abortion in 1952—53.

² Including one case subsequently pregnant.

of these twelve. Nine of the 12 had undergone vaginal hysterotomy, one dilatation of the cervix and curettage, and two abdominal hysterotomy and resection of both tubes. Of the two tabulated patients with anovulatory cycles, one was aged 46 at the follow up and had not been pregnant since the legal abortion; the other, who had undergone interruption of pregnancy and sterilization, had since had regular menstrual bleeding for six months after treatment with estrogens, followed by amenorrhea for more than three months; the latter condition was still present three months after the biopsy. Prior to the legal abortion this patient had had irregular menstruations with intervals of up to two months.

Taking the above findings into consideration, it appeared that fairly persistent disturbances of the ovarian function had arisen only in two of the 11 patients with protracted postoperative

amenorrhea who were possible to examine in this respect. In each of these two, however, it was somewhat uncertain whether the pertinent operations had any major bearing on the observed disturbances in the ovarian function. With the possible exception of one or two cases, the operations of 1952—53 did not, therefore, seem to have caused protracted amenorrhea which had begun immediately thereafter and was due to fairly persistent disturbances of the ovarian function.

In a number of cases the intervals between menstruations had changed after the operations of 1952—53. In some of them these disturbances were probably of relatively short duration. The types of menstruation are here classified as follows:

Regular menstruations: Those with intervals of at least 21 but not more than 35 days.

Irregular menstruations: Those with intervals varying by more than 14 days but not exceeding 60 days.

Oligomenorrhea: Menstruations at intervals exceeding two but not four months.

Amenorrhea: No menstruation for at least six months.

Tables 51 and 52 show the intervals between menstruations and the signs of ovulation in patients who had undergone vaginal hysterotomy and in those who had been subjected to abdominal hysterotomy and sterilization in 1952—53.

Of the remaining 55 patients in the series, two had had irregular menstruations after the operations of 1952—53 (dilatation of the cervix and curettage in one; laminaria dilatation, curettage and bilateral salpingectomy in the other). In two other cases the intervals between menstruations had changed by one week. Each of these four patients was found to have ovulated since the operations of 1952—53.

From the tables and the above data it emerges that irregular menstruations or, occasionally, amenorrhea had arisen in 41 (4.1 per cent) of the cases. The patient who had undergone radiologic castration before the follow up was not included in this analysis. Minor changes in the intervals between menstruations had occurred

Table 51. *Intervals between menstruations and signs of ovulation in cases of vaginal hysterotomy in 1952—53.*

Type of menstruation before and after legal abortion carried out in 1952—53	Secretory phase	Biopsy taken; secretory phase not shown		No endometrial biopsy taken ⁴		Total
		Pregnancy after legal abortion	No pregnancy after legal abortion	Pregnancy after legal abortion	No pregnancy after legal abortion	
Regular; regular	495	8	8	146	68	725
Irregular; irregular	7	—	1	4	—	12
Oligomenorrhoea; oligomenorrhoea	—	—	1 ¹	—	—	1
Regular; irregular	15	1	1	6	2	25
Regular; oligomenorrhoea	3	1	1 ²	—	—	5
Regular; amenorrhoea ..	—	—	—	1 ³	—	1
Regular; regular but interval changed by 1 week	34	5	—	8	2	49
Irregular; regular	14	—	1	3	1	19
Total	568	15	13	168	73	837

¹ Aged 46 when examined; hypoplastic endometrium with slight cyclic changes.

² During and following confinement to mental hospital, intervals had ranged up to 4 months; but earlier, after the legal abortion, menstruations had been regular for 7—8 months. Endometrium showed no signs of cyclic activity.

³ X-ray castration before the follow-up.

⁴ Including 7 cases in which biopsy was not taken during the last 16 days before menstruation. Regular menstruation in 6 cases, amenorrhoea after X-ray castration in one. Four of these cases pregnant after the legal abortion.

in 59 cases. The disturbances in question showed a comparatively even distribution in relation to different types of operations. In the majority of cases with these disturbances it was possible to study the ovarian function. Of the above-mentioned 41 patients,

Table 52. *Intervals between menstruations and signs of ovulation in cases of abdominal hysterotomy and sterilization in 1952—53.*

Type of menstruation before and after legal abortion and sterilization, carried out in 1952—53	Secretory phase	Biopsy taken; secretory phase not shown	No endometrial biopsy	Total
Regular; regular	87	—	11	98
Irregular; irregular	1	—	—	1
Regular; irregular	6	—	1	7
Regular; oligomenorrhoea	1	—	—	1
Irregular; amenorrhoea ..	—	1	—	1
Regular; regular but interval changed by 1 week ..	6	1	1	8
Irregular; regular	4	1	—	5
Total	105	3	13	121

35 were found to have ovulated since the operations of 1952—53; three possibly had anovulatory cycles, and in the remaining three satisfactory investigation was not possible. Most of the 59 patients with minor changes in the intervals between menstruations were shown to have ovulated since the operations of 1952—53.

In some of the aforementioned 41 cases the changed intervals were possibly due to disturbances not associated with the operations. For instance, table 51 includes one patient who, following the legal abortion, had regular menstruations for 7—8 months, but then showed oligomenorrhoea during and after confinement to a mental hospital. The patient with amenorrhoea after legal abortion and sterilization, had had irregular menstruations prior to the interrupted pregnancy. One patient with irregular menstruations after vaginal hysterotomy claimed to have had similar irregularities when she had been younger, but comparatively regular intervals during the last few years before the legal abortion.

DISCUSSION

Nothing was known concerning anatomical changes of the ovaries prior to the operations of 1952—53. It was therefore uncertain if the latter had any causal relationship to such changes that were found. The incidence of ovarian cysts exceeded that (< 0.4 per cent) found in a normal series by Macmill, Menduke & Cava (1955). However, the present cases included those with only very slightly enlarged, though cystic ovaries. Moreover, several of these patients underwent repeated clinical examinations over a long period. These circumstances possibly explained the higher incidence (just under 1.5 per cent) of ovarian cysts observed in this series. This investigation accordingly failed to verify the observation, made by Russian investigators (*vide* Mayer, 1933), that the relevant operations give rise to cystic degeneration of the ovaries.

In evaluation of the ovarian function, endometrium in the secretory phase was considered to indicate that ovulation had occurred. In the great majority of cases the functional state of the endometrium was evaluated from studies of small endometrial fragments secured at biopsy. In accordance with observations reported by Meigs (1939), Burch & Phelps (1943), Sjövall, Genell & Thorén (1950) and Noyes (1956), it was considered justified to regard these small fragments as being representative of the endometrium in its entirety in the pertinent respect. In evaluating the ovarian function, the fact was not taken into account that most patients had been subjected to hysterosalpingography before the endometrial biopsy. That the trauma which hysterosalpingography constitutes may affect the ovarian function was demonstrated by Birnberg (1937), Rock & Bartlett (1937) and Bergman (1950).

The reported times of onset of menstruation were sometimes unreliable. For this reason the exact point in the menstrual cycle at which endometrial biopsies were taken was not known in several of those patients who were considered to have anovulatory cycles. These biopsies had possibly been taken more than 16 days before the next subsequent menstruation. With the guidance of Bergman's (1950) investigations, the incidence of anovulatory cycles

was calculated on the assumption that the duration of the secretory phase does not exceed 16 days. According to that author's observations it seemed likely, moreover, that endometrium in the secretory phase would have been found more often had the biopsies consistently been taken only a few days before the next subsequent menstruation. It seemed possible, therefore, that a number of the cycles that were considered anovulatory would in fact have proved to be ovulatory if endometrial specimens had been secured at more apposite times.

To render the present series comparable with earlier ones in regard to the incidence of anovulatory cycles, that incidence was calculated solely on the basis of those cases with anovulatory cycles where endometrial biopsies had not been taken earlier than ten days before the onset of the next menstruation. The figure that emerged — 3.3 per cent — was lower than corresponding incidences in the majority of previously reported series. Westman (1939) alone gave a possibly somewhat lower figure in a series of sterility cases; otherwise, figures of between 3.8 and 11 per cent were reported by Schröder (1938), Rock, Bartlett & Matson (1939), Sharman (1944), Levan & Szanto (1944), Zondek (1947), Johnstone (1948), Felding (1949), and Bergman (1950, 1956). However, these calculations had been made, as a rule, in sterility cases. In the present series of patients who had undergone legal abortions with or without sterilization, the incidence of anovulatory cycles prior to those operations was unknown. Comparison with the above-mentioned authors' figures nevertheless did not suggest that those operations had led to a higher incidence of anovulatory cycles.

Levan & Szanto (1944) and Felding (1949) found, in the same cases, alternating anovulatory and ovulatory cycles. A number of Bergman's (1956) patients with anovulatory cycles subsequently became pregnant. The same applied to a considerable number of the present patients, who were thus capable of ovulation in other menstrual cycles. It seemed not unlikely that the observed incidence of anovulatory cycles in this series was largely due to such variations in the ovarian function that were demonstrated by Levan & Szanto (1944), Felding (1949), and Bergman (1956) and which, according to Wharton (1947), occur

in normal cases. In this series the patients with anovulatory cycles who later became pregnant had undergone hysterosalpingography and endometrial biopsy. The possibility could not be precluded that the subsequent ovulation was a salutary effect of previous examinations. Trauma to the uterus, as pointed out in the foregoing, may affect the ovarian function.

Earlier investigations of major series after similar operations yielded no reliable data on the incidence of anovulatory cycles. Russian authors (*vide* Mayer, 1933) found high incidences of disturbances in the ovulatory process as a result of the operations. It has previously been observed that a large number of patients who had undergone legal abortions became pregnant once more within a relatively short time (*cf.* the section on fertility after those operations). — Arén, Bergman & Eliasson (1957) found, in patients who had been subjected to legal abortions, an incidence of conception equally high as that in a normal series. These circumstances suggested that anovulatory cycles had not arisen to an appreciable extent in consequence of the relevant operations. Suzuki & Watanabe (1954) observed signs of disturbed ovarian function during the menstrual cycles that followed interruptions of pregnancy, and more often in patients whose pregnancies had exceeded 76 days; however, all patients showed a normal ovarian function during the third menstrual cycle after the operations.

The reported durations of amenorrhea following the operations appeared to be unreliable, the information having been obtained some considerable time afterwards. Most of the 12 patients who had long periods of amenorrhea were found to have ovulated. — Russian investigators (*vide* Mayer, 1933) had observed a disturbed ovarian function with amenorrhea far more often.

The reported intervals between menstruations were probably somewhat unreliable, too, in many cases. In some patients the disorders were likely to have been of fairly short duration. The above-mentioned changes of the intervals apparently did not, in most cases, point to any serious disturbance of the ovarian function, since the majority were found to have ovulated. In a few cases it seemed uncertain what bearing the operations had had on the

altered intervals, since other factors of probable significance had been present.

The observed incidence of irregular menstruations — 41 (4.1 per cent) of 1,012 cases, excluding one patient with amenorrhea after radiologic castration — did not differ substantially from corresponding figures reported by Feniger & Wetterdal (1947), Lork (1948), Svanberg (1949), and Holtz (1950). Higher incidences had been found by Russian authors (*vide* Mayer, 1933) and by Engel (1953).

Most of the patients with signs of disturbed ovarian function consisting of irregular menstruations or amenorrhea following the operations of 1952—53, were examined with respect to ovarian function. As a rule they had been subjected to endometrial biopsy during the last 16 days before menstruation or had been pregnant since those operations. Corresponding examinations were impracticable in a total of 97 cases. It seemed unlikely that anovulatory cycles would be commoner in these 97 patients than in the rest of the series; this on the assumption that protracted amenorrhea after the operations or irregular menstruations were manifestations of anovulatory cycles. As regards the incidence of these latter, the patients in whom the ovarian function was investigated were therefore considered representative of the total series.

SUMMARY

Ovarian cysts were found in 15 cases, in the majority of which they were not more than eggsized. They had not demonstrably resulted from the operations of 1952—53.

If the duration of the secretory phase was considered not to exceed ten days, the incidence of anovulatory cycles amounted to 3.3 per cent of 731 cases examined.

Comparison with the reported incidences of anovulatory cycles in other series did not suggest that the operations of 1952—53 had given rise to disturbances of the ovarian function associated with an increased incidence of anovulatory cycles.

Anovulatory cycles were found in all age groups and in patients whose interrupted pregnancies had varied between 9 and 24 weeks

in duration. There was no demonstrable correlation between the incidence of anovulatory cycles and the various types of operations.

In 1.2 per cent of the cases there had been postoperative amenorrhea exceeding three months in duration; 4.1 per cent of the patients claimed to have had irregular menstruations, oligomenorrhea or amenorrhea after the operations. Amenorrhea lasting more than six months occurred in one case. In several cases it seemed doubtful if the operations had any causal relationship to these disturbances. The majority of patients with such disturbances showed no other abnormalities in the ovarian function.

H. FERTILITY

The fertility was evaluated on the basis of intrauterine pregnancies occurring after the legal abortions of 1952—53, and of the findings at hysterosalpingography and endometrial biopsy.

Of 881 patients who had undergone legal abortions in 1952 or 1953, 168 had intrauterine pregnancies thereafter but were not examined by means of hysterosalpingography, etc. Eighty-seven patients, all of whom had sought to avoid pregnancy after the operations of 1952—53, did not become pregnant thereafter and did not undergo satisfactory investigation of their fertility. The remaining 626 patients, a number of whom had further pregnancies after the operations of 1952—53, were investigated by means of hysterosalpingography and studies of the ovarian function. All 881 cases are listed in table 53.

In the 626 tabulated patients who were subjected to hysterosalpingography, etc. the fertility was considered intact if they showed at least one normal tube and signs of ovulation after the operations of 1952—53, and also if they had had intrauterine pregnancies thereafter. As pointed out in an earlier section on the ovarian function, it was often difficult to estimate the point in the menstrual cycle at which endometrial biopsies had been taken. Those patients whose biopsy specimens showed an ordinary proliferative endometrium were therefore considered to have a normal ovarian function if they became pregnant after the operations of 1952

Table 53. *Fertility after legal abortion in 1952-53.*

Operative method	Examination by hysterosalpingography, etc.					No investigation including both hysterosalpingography and adequate examination of ovarian function		Total
	Fertile	Infertility or impaired fertility				Pregnancy after legal abortion	No pregnancy after legal abortion	
		Ovulation not demonstrable	No satisfactory filling of tubes, tubal function not demonstrable ^a	Bilateral salpingitis	Endometritis			
Dilatation of cervix and curettage	23	2	—	—	—	7	8	40
Vaginal hysterotomy . .	572	15 ¹	3 ¹ ,	6 ¹	1 ³	161	79 ¹	837
Abdominal hysterotomy	3	—	1 ⁴ ,	—	—	—	—	4
Total	598	17	4	6	1	168	87	881

¹ Including one case of endometritis.² No intrauterine pregnancies after the legal abortions in 1952-53.³ Gonorrheal infection between legal abortion and follow up.⁴ Enucleation of myoma concurrently with the legal abortion.

—53. Impaired fertility was considered to be present in two patients who had intrauterine pregnancies after the follow up but had shown, at the latter, glandular hyperplasia with signs of glandular cystic hyperplasia, and a proliferative phase and endometritis, respectively. Anovulatory cycles were taken to have been present if no signs of ovulation were detectable in endometrial biopsies taken within 16 days before the next subsequent menstruation.

It is evident from the table that intact fertility was not demonstrable in 28 (4.5 per cent) of the 626 patients who had been studied in this respect by means of hysterosalpingography, etc., or in 4.6 per cent of 627 patients if all cases of endometritis were included. In four patients without signs of ovulation since the operations of 1952—53, endometrial biopsy had been performed more than ten days before the next subsequent menstruation. The ten cases tabulated above that showed impaired fertility or sterility as a result of salpingitis or other tubal changes — i.e., deficient contrast filling of the tubes — and hence had had no intrauterine pregnancies since the operations of 1952—53, were reported in the foregoing section on pathologic changes in the tubes. It will be seen from that report that inflammatory changes which were considered to have produced bilateral tubal occlusion and sterility, and were attributed in their entirety to the legal abortion, had possibly arisen only in one case. Five patients who had undergone operations for salpingitis before or who had bilateral salpingitis at the follow up showed tubal lesions which may, in part, have been present before the legal abortions and been aggravated by the latter. Two of these five nevertheless showed contrast passage at hysterosalpingography, so that the degree of fertility impairment was uncertain; the other three, who had undergone bilateral salpingectomy, were sterile. In the remaining four of the ten cases there was no satisfactory contrast filling of the tubes, for reasons unknown.

Endometriosis-like changes in the tubes were observed in two patients. But since each of these had intrauterine pregnancies after the legal abortions, the tubal lesions had not demonstrably impaired the fertility.

As pointed out in the section on pathologic changes in the corpus

uteri, the relationship between legal abortions and endometritis detected at the follow up was obscure. In the patient who, aside from endometritis, showed no sign of impaired fertility the course following the legal abortion had been quite uneventful.

Numerous patients became pregnant again after the interruptions of pregnancy in 1952—53. Of 881 patients, 121 (13.7 per cent) had a further pregnancy within one year, and 225 (25.4 per cent) within two years after those operations. Nineteen of the latter 225 became pregnant twice during the period in question. These figures refer solely to intrauterine pregnancies. Two patients had extrauterine pregnancies within two years after the legal abortions; one of them also had an intrauterine pregnancy during the same period. The above data on further pregnancies after the operations of 1952—53 were probably incomplete. This applied in particular to pregnancies occurring within two years, for numerous patients could not be followed up for more than a year or so after the operations of 1952—53. Furthermore, the figures were largely based on information furnished by the patients themselves, and hence were possibly too low.

The great majority of patients had sought to avoid further pregnancies after the legal abortions. Five, all of whom had undergone vaginal hysterotomy in 1952—53, had nevertheless been involuntarily sterile for more than one year thereafter. Three of them had intrauterine pregnancies after the follow up, including two who had been investigated by means of hysterosalpingography, etc. and had shown no abnormalities that might have affected the fertility. Nor did a fourth case exhibit any changes of significance, on hysterosalpingography and endometrial biopsy. This patient was still involuntarily sterile one year after the follow up; her partner was not available for examination. The fifth patient was considered to have, probably as a result of the legal abortion, bilateral salpingitis with occlusion of the tubes; her partner exhibited impaired fertility (four spermatozoa per 200 fields). In one of five cases with involuntary sterility of long duration, it appeared likely, therefore, that the legal abortion had caused sterility due to organic lesions.

In two patients with complications consisting of hemorrhage that necessitated re-suture or re-curettage, and in one with in-

complete abortion after the interrupted pregnancy, no satisfactory investigation of the fertility was possible. One patient with obscure pain following the legal abortion underwent, between that operation and the follow up, bilateral salpingectomy for salpingitis. Since, however, the latter condition had been present at the time of the legal abortion, it was not clear if that operation had any bearing on the pain. All of the other patients with complications in the genital organs directly after the operations of 1952—53 showed no demonstrably impaired fertility when followed up, or had intrauterine pregnancies later on. Postoperative complications could not, therefore, be shown to have impaired the fertility.

The condition of the tubes in cases with disturbances observed three weeks after the legal abortions is shown in table 48. Aside from two with cervicitis who possibly had anovulatory cycles, all of the tabulated patients that underwent hysterosalpingography were found to have ovulated since the operations of 1952—53. No functionally or anatomically intact tubes were demonstrable in three cases subjected to hysterosalpingography. However, the significance of the legal abortions relative to tubal lesions in these three cases was very uncertain; for in two of them, subjected to bilateral salpingectomy for salpingitis before the follow up, there had been salpingitis prior to the legal abortions; and in the third the reason for defective contrast filling of the single remaining tube was unknown. At the follow up, this latter patient also had endometritis, but whether it was due to the legal abortion was uncertain. The inflammatory conditions observed three weeks after the legal abortions, and probably due entirely to those operations, thus were not definitely found to have affected the fertility.

DISCUSSION

It will be observed from the foregoing that in calculating the incidence of impaired fertility attributable to the operations of 1952—53, consideration was given solely to the anatomical or functional state of the tubes and ovaries, and to the occurrence

of endometritis. Pathologic changes in the cervix and isthmus or other lesions in the corpus uteri were not taken into account, since it was difficult as a rule to ascertain the extent to which they constituted sequelae of those operations and the degree to which they affected the fertility. On the other hand, the possibility that in some cases they were significant from the standpoint of fertility could not be ruled out. A number of patients reported irregular menstruations after the legal abortions, but in some of them the disorders had probably been of relatively short duration. They, too, were accordingly disregarded when evaluating the fertility. Nor was it taken into account that the relevant examinations had possibly influenced the ovarian function. Pregnancies occurring after the follow ups in patients who, judging be endometrial biopsies, had not ovulated, were conceivably due to a salutary effect of the examinations.

It was pointed out in earlier sections that it appeared very uncertain whether deficient contrast filling of the tubes at hysterosalpingography was consistently due to pathologic changes which had resulted from the legal abortions. Nor had the latter demonstrably given rise to an increased incidence of anovulatory cycles. Possibly the observed anovulatory cycles were mostly manifestations of normal variations in the ovarian function. It was not clear if the legal abortions had any causal relationship to endometritis. Substantial and protracted impairment of the fertility as a result of the legal abortions therefore seemed apparent only in those patients who showed bilateral inflammatory changes in the tubes.

The majority of the 87 patients who had neither become pregnant nor had undergone investigation of their fertility after the legal abortions, were not subjected either to hysterosalpingography or endometrial biopsy. In some hysterosalpingographically examined cases endometrial biopsies were taken at an unsuitable point in the menstrual cycle. It will be clear from the foregoing sections that those patients who were not investigated with respect to the anatomical or functional state either of the tubes or the ovaries, were unlikely to have differed appreciably from the others in regard to the incidence of such disturbances in those organs that were attributable to the legal abortions. Since the fertility was

evaluated from the condition of the tubes and ovaries, there was no evidence that the legal abortions had impaired it far more often in the above-mentioned 87 cases than in the rest of the series.

The incidence of cases without demonstrably intact fertility amounted to 4.6 per cent at the most. In the majority of previously reported series in which the operations had largely been of the same types as those performed here, the sterility figures varied between 0.9 and 6 per cent (Russian authors, *vide* Mayer, 1933; Feniger & Wetterdal, 1947; Svanberg, 1949; Holtz, 1950; Kolonja & Ulm, 1952; Kolstad, 1958). However, Asherman (1953) and Engel (1953) reported higher incidences, though the former author's series differed in important respects from the present one and hence was not comparable with it. These data from earlier investigations apparently referred chiefly to the incidence of involuntary sterility; there seems to have been but little detailed study of the fertility. Previously reported results were not, therefore, comparable with those found in this investigation.

One circumstance suggesting that legal abortions do not give rise to sterility on any appreciable scale is that a large proportion of pregnancies has been observed within a relatively short time after the operations (Svanberg, 1949; Holtz, 1950; Koya: *vide* Inghé, 1954; Ekblad, 1955; Mehlan, 1956; Koya & Muramatsu, 1956; Arén, Bergman & Eliasson, 1957). In series reported by Koya & Muramatsu (1956), 65 per cent of the patients had further pregnancies within 18 months; in those communicated by Arén, Bergman & Eliasson (1957) the incidence of fresh pregnancies within three years after the legal abortions amounted to 40 per cent. The latter authors also showed that the incidence of conception in patients who had undergone interruptions of pregnancy was equal to that in a normal series. In the present series the available figures for pregnancies occurring within a few years after the legal abortions were not sufficiently reliable, however, for comparison with other authors' data.

According to Russian investigators (*vide* Mayer, 1933), women who have undergone three or four interruptions of preg-

nancy are, as a rule, sterile as a result of the operations. In this series only a few patients had undergone more than two legal abortions. Hence it was not possible to determine whether repeated interruptions of pregnancy impair the fertility to any major extent.

SUMMARY

Of 881 patients who had undergone legal abortions in 1952—53, 626 were investigated by means of hysterosalpingography and studies of the ovarian function; 168 who had intrauterine pregnancies after those operations were not subjected to similar examinations. The remaining 87 were neither studied with respect to their fertility nor had been pregnant since the operations.

In the first-named group of 626 cases the incidence of impaired fertility did not exceed 4.5 per cent and possibly was much lower. Pathologic changes associated with persistent sterility were found in three or four cases. It was often uncertain if the operations of 1952—53 had any causal relationship to those lesions that were considered to produce sterility or impairment of fertility. In three of the above-mentioned sterile patients there might well have been other contributory causes of the sterility. A lasting disturbance of the fertility, probably due entirely to the legal abortion, was considered to have been present in one case only.

Disregarding a few patients who had already suffered from salpingitis before the legal abortions of 1952—53, postoperative complications or inflammatory conditions that were found in the genital organs three weeks after those operations, had no demonstrable bearing on persistent disturbances of fertility.

Involuntary sterility had been present in five of 881 patients. One of these five was thought to be sterile, probably as a result of the legal abortion; the other four showed no appreciable impairment of fertility.

I. ENDOMETRIOSIS IN ABDOMINAL SCARS FOLLOWING ABDOMINAL HYSTEROTOMY

A total of 125 patients had undergone abdominal hysterotomy, with or without sterilization, in 1952—53. In one of them, endometriosis was observed in the abdominal scar at follow up after 2—3 years. It was localized to the extreme right of the scar from a Pfannenstiell incision. In this case there had been no other hysterotomy, but the patient had earlier undergone appendectomy via an incision over the right iliac fossa.

The reported incidences of endometriosis in abdominal scars following abdominal hysterotomy range from less than 1 per cent up to 10 per cent (Waldhard & Burkhard, 1932; Wespil & Kletzhändler, 1940). See also Nora, Meyer & Carbonera, (1956). It seemed likely that the case mentioned above was due to the abdominal hysterotomy. However, endometriosis has been found in different parts of the body, without any detectable etiologic factor. Moreover, the patient reported here had also undergone appendectomy with the abdominal incision at approximately the site of the subsequently observed endometriotic changes. The latter operation conceivably had a causal relationship to those changes (Novak, 1947). — It will be seen from table 17 that 110 of 125 patients who had undergone abdominal hysterotomy were followed up within two years. Thus the follow-up period was relatively short in most cases, which possibly explained why endometriosis was observed only in one of them. The significance of long follow-up periods for the detection of endometriosis in vaginal hysterotomy scars was pointed out in an earlier section.

Thus, of 125 patients who had been subjected to abdominal hysterotomy in 1952—53, only one (i.e., somewhat less than 1 per cent) had endometriosis in the abdominal scar probably as a result of the operation. It seemed not unlikely that the danger of endometriosis arising in the abdominal wall was greater than would appear from the above figure.

J. COURSE OF SUBSEQUENT DELIVERIES

Patients who had undergone interruptions of pregnancy in 1952—53 subsequently had a total of 265 childbirths at departments of obstetrics. In those who had been subjected to dilatation of the cervix and curettage there were six childbirths, all of them with a normal course aside from one case with hemorrhage exceeding 600 cc. The other 259 deliveries were in patients who had undergone vaginal hysterotomy. The courses are detailed in table 54.

Table 54. *Course of deliveries after legal abortion by vaginal hysterotomy, carried out in 1952—53.*

Normal delivery	215
Twin pregnancy	4
Retained placenta	4
Uterine inertia; no operative measures	5
Uterine inertia, forceps	4
Threatened asphyxia of fetus; forceps	3
Hemorrhage exceeding 600 cc	17
Premature separation of normally situated placenta	2
Placenta praevia	1
Toxicosis; cesarean section	2
Toxicosis; artificial rupture of the membranes	1
Toxicosis; intrauterine asphyxia	1
Total 259	

The percentages of the observed complications in this series did not differ essentially from the corresponding figures in a major, contemporaneous obstetrical series reported by Arén, Bergman & Eliasson (1957). Major hemorrhages were, it is true, somewhat commoner in the present series, but the latter was too small to warrant any definite conclusions. Accordingly, the legal abortions had not demonstrably heightened the chances of complications at subsequent childbirths. Holtz (1950) and Kolonja & Ulm (1952) made similar observations; but other authors such as Klein (1927), Bronnikowa (1929), Russian investigators

quoted by Mayer (1933), Svanberg (1949), Olsen (1950), and Arén, Bergman & Eliasson (1957) had found a higher incidence of complications in patients who had undergone interruptions of pregnancy.

Thus, the course of 265 childbirths did not suggest that the legal abortions in this series had substantially increased the danger of complications at later deliveries.

K. MENORRHAGIA, HYPOMENORRHEA AND METRORRHAGIA

In the interval between the operations of 1952—53 and the first follow up, comprising the entire series and conducted within four years, a number of patients claimed to have had menorrhagia or hypomenorrhea that had appeared or exacerbated since the operations, or metrorrhagia. These disturbances are detailed in table 55. They had not been present in patients who had undergone dilatation of the cervix to Hegar 13 and curettage, or laminaria dilatation, curettage and sterilization. Often it was somewhat doubtful if the menstrual disorders that were reported had in fact differed appreciably from what could be regarded as normal. With the exception of a few cases, there had probably been no major disturbances of those types. Prior to the follow up, 14 patients had undergone curettage for menorrhagia or metrorrhagia; two of them, as well as an additional 34, were subjected to that operation for the same conditions in connection with the follow up. In the other cases the disturbances had been so mild or had occurred so long ago that no special measures were indicated at the follow up.

Excluding the three tabulated cases with amenorrhea, 2.9 per cent of the patients claimed to have had menorrhagia, 0.7 per cent menometrorrhagia, 2.5 per cent hypomenorrhea, and 6.6 per cent metrorrhagia.

In patients with menorrhagia or metrorrhagia there had been no direct postoperative complications, nor any demonstrably higher incidence of inflammatory conditions on examination three

Table 55. *Occurrence of menstrual disorders and irregular bleeding after legal abortion carried out in 1952—53.*

	Dilatation of cervix H. 17 and curettage	Vaginal hysterotomy	Abdominal hysterotomy	Abdominal hysterotomy and sterilization	Legal abortion by the vaginal route and sterilization	Total
No menstrual disorder or status quo, and no ir- regular bleeding	20	739	3	99	3	864
Hypomenorrhea	3	15	—	5	—	23
Hypomenorrhea and metrorrhagia	—	2	—	—	—	2
Metrorrhagia ..	4	48	—	13	—	65
Meno- metrorrhagia ..	—	6	1	—	—	7
Menorrhagia ..	—	25	—	3	1	29
Amenorrhea	—	2	—	1	—	3
Total	27	837	4	121	4	993

weeks after the operations than in the rest of the series. Between those operations and the follow up, seven of them had had salpingitis or gonorrhea, and five cervicitis, endometritis or endometrial polyps. In most cases there were no grounds to attribute these conditions to the operations of 1952—53.

The findings in patients with the aforementioned disturbances are listed in table 56, which details the results of the first follow up comprising the entire series and conducted within four years after the operations of 1952—53.

It is evident from the table that a number of patients were examined neither by means of hysterosalpingography nor by curettage or endometrial biopsy, but most of these had intrauterine pregnancies after the operations of 1952—53. Hence the latter had scarcely given rise to serious inflammatory changes in the genital organs in the relevant cases. The only lesion of inflammatory nature observed in an appreciable number of cases was cervical erosion; and as pointed out elsewhere, it could not always

Table 56. *Findings on examination of cases of menstrual disorders or irregular bleeding after legal abortion carried out in 1952-53.*

	Menorrhagia	Meno- metrorrhagia	Metrorrhagia	Hypo- menorrhea
Total of cases	29	7	67 ⁶	25 ⁶
Cervical erosion	—	—	13 ³	—
Endometriosis in vaginal hysterotomy scar ¹	—	1	14 ⁴	—
Fixation of uterus	—	—	2	—
Hysterosalpingography: N. A. D. ²	25	7	50 ⁵	21
Hysterosalpingography not carried out; intra- uterine pregnancy after legal abortion	3	—	14	3
Secretory phase	24	5	43	20
Proliferative phase	—	1	6	1
Glandular hyperplasia with signs of glandular cystic hyperplasia	—	1	—	—
Endometrial polyp ..	1	1	—	—
Endometritis	—	1	—	—
Pregnancy after legal abortion; endometrial biopsy not taken	4	—	16	3
No pregnancy or endo- metrial biopsy	1	—	2	1

¹ Thirteen of these 15 patients had had vaginal hysterotomy in 1952-53.² Excluding any changes of unclear character such as cavities and fistulae in the isthmic wall; and funnel-shaped recesses in the uterine wall. Such changes were not commoner in these tabulated cases than in the remaining cases of this series.³ Including one case of cervical carcinoma.⁴ Including two cases of cervical erosion.⁵ Including one case of bilateral salpingectomy for salpingitis prior to hysterosalpingography; and one case of intravascular contrast filling.⁶ In two cases both metrorrhagia and hypomenorrhoea.

be attributed to the operations of 1952—53. Endometriosis was relatively common in patients with metrorrhagia; hence it was not implausible to assume that in a small number of cases it had given rise to the latter condition. Since most of the tabulated patients were found to have ovulated since the operations of 1952—53, the disturbances in those cases scarcely pointed to any serious and persistent disorder of the ovarian function. Moreover, it was not unlikely, as pointed out elsewhere, that ovulation had also occurred in patients who showed proliferative endometrium. The therapeutic effect of curettage performed in 14 cases between the operations of 1952—53 and the follow up could not be evaluated. A few patients had been pregnant between the legal abortions and follow up; possibly these pregnancies had a bearing on the relevant disturbances. As regards the incidence of such pathologic conditions that were conceivably of significance thereto and had resulted from the operations of 1952—53, the tabulated cases did not differ appreciably from the rest of the series, if endometriosis be disregarded. As pointed out earlier, postoperative complications or disturbances observed on examination after three weeks were not commoner in patients with menstrual disorders or irregular bleeding than in the others. Having regard to all of these findings, it was doubtful if the operations of 1952—53 had given rise, on any appreciable scale, to fairly pronounced menorrhagia, metrorrhagia or hypomenorrhea.

In the interval between the operations and the first follow up comprising the entire series and conducted within four years after the operations, menorrhagia, menometrorrhagia, hypomenorrhea and metrorrhagia were thus claimed to have arisen or exacerbated in, respectively, 2.9, 0.7, 2.5 and 6.6 per cent of the cases. In the great majority, these disturbances had not demonstrably resulted from the operations.

L. DYSMENORRHEA, DYSPAREUNIA AND LOWER ABDOMINAL PAIN

This report is based on the results of the first follow up, which comprised the entire series and was conducted within four years after the operations of 1952—53.

Dysmenorrhea, lower abdominal pain (excluding dysmenorrhea and dyspareunia), and dyspareunia were recorded in numerous cases. Since the investigation was concerned with deleterious effects of the operations of 1952—53, attention was chiefly given to cases with painful conditions that had arisen or been aggravated since those operations and were of appreciable intensity and duration.

Fresh or increased dysmenorrhea was found in 7.3 per cent (milder or abolished dysmenorrhea in 10.8 per cent) of the patients. Fresh or aggravated lower abdominal pain, excluding dysmenorrhea and dyspareunia, was recorded in 4.8 per cent of the cases; fresh or increased dyspareunia in 4.3 per cent of the 943 patients who had had coitus since the operations of 1952—53. In patients who had undergone vaginal hysterotomy in 1952—53, the corresponding incidences were 7.3, 4.3 and 4.5 per cent respectively. Of the total of 135 patients with fresh or aggravated pain, five had undergone dilatation of the cervix to Hegar 17 and curettage, 113 vaginal hysterotomy, 16 abdominal hysterotomy and sterilization, and one laminaria dilatation, curettage and sterilization. In the above-mentioned total of 22 patients who had not undergone vaginal hysterotomy, the various types of painful conditions showed a fairly even distribution in relation to the types of operations. Severe pain, in some cases producing disability, was reported by 25 patients, two of whom had undergone dilatation of the cervix to Hegar 17 and curettage, and the other 23 vaginal hysterotomy. The remaining 110 had slight to moderate pain.

One hundred and one patients with painful conditions were subjected to hysterosalpingography and curettage or endometrial biopsy. Of the remaining 34 patients, 24 had intrauterine pregnancies after the operations of 1952—53. Ten, including one who

had also been sterilized, were not examined by means of hysterosalpingography and had no further pregnancies.

It was often extremely difficult to determine if the operations of 1952—53 had any causal relationship to the painful conditions. Information furnished by the patients sometimes appeared to be unreliable. In a number of cases with uneventful postoperative courses and no detectable pathologic changes, the pain had first been felt several months or more after the operations. Numerous patients had had genital tract infections before the operations, but possibly the latter had activated pre-existing inflammatory conditions, which had thereby aggravated the symptoms or given rise to new ones. Others had, some time between the operations and follow up, suffered from genital tract infections not attributable to the operations; there had also been pregnancies or surgical measures on the genital organs. These conditions and operations possibly had a bearing on the development of symptoms referable to the genital organs. The same applied to several patients with pathologic changes, e.g. endometriosis, as a result of the operations of 1952—53. Some patients showed lesions that might have given rise to symptoms but could not be ascribed with assurance to the operations; for example, cervical erosions, and endometriosis in hysterotomy scars in patients who had undergone a vaginal hysterotomy in addition to that performed in 1952 or 1953. There were observed in several cases, though not to an appreciably greater extent than in the rest of the series, lesions of unknown nature and significance, such as fistulae and cavities detected in the isthmic wall at hysterosalpingography. It appeared doubtful, moreover, whether quite small endometriotic changes in hysterotomy scars could give rise to appreciable pain.

The investigation had certain shortcomings. It seemed likely, as pointed out elsewhere, that the incidence and extent of endometriosis were underestimated. A number of patients with fresh or aggravated pain were not subjected to hysterosalpingography or curettage. The majority of them had intrauterine pregnancies after the operations of 1952—53 and showed no appreciable disease on clinical examination, so that the operations were not likely to have produced any extensive pathologic changes in the genital tract. However, the state of the genital organs could

not be ascertained in these cases. The same applied to a few in which, for reasons unknown, there was no satisfactory contrast filling of the tubes at hysterosalpingography. Furthermore, the majority of cases were subjected only to endometrial biopsy and not curettage.

Only in a few of the patients with fresh or aggravated pain had there been direct postoperative complications. In some groups, however, elevated postoperative temperatures and disturbances observed at examination after three weeks had been relatively common. These were nevertheless of doubtful significance, since, at follow up, no inflammatory changes were found which had demonstrably resulted from the operations of 1952—53. The few patients with fresh or increased pain as well as salpingitis at the follow up, had already suffered from salpingitis before those operations. Endometriosis in hysterotomy scars or adjacent parts of the uterus or urinary bladder was somewhat commoner in some groups with fresh or aggravated pain than in the rest of the series. The occurrence of endometriosis in the pertinent cases has already been reported (see page 59). It seemed unlikely, as will be evident from that report, that pain due to endometriosis had arisen in more than a few cases. In the majority with endometriosis resulting from the operations of 1952—53, that pathologic change did not seem to have any definite causal relationship to the painful conditions recorded at the first follow up within four years after the operations.

Other changes observed at the follow up, and probably attributable to the operations, were not appreciably commoner in patients with fresh or increased pain than in the others. Their significance in the relevant respect was accordingly doubtful. Somewhat over one-half of all cases with the painful conditions in question showed no pathologic changes that were likely to have been of causal significance. In the great majority, no organic lesions were detected that had demonstrably resulted from the operations of 1952—53.

At the first follow up of the series, which was conducted within four years after the operations of 1952—53, fresh or aggravated pain in the form of dysmenorrhea, lower abdominal

pain (excluding dysmenorrhea and dyspareunia), and dyspareunia was accordingly reported by, respectively, 7.3, 4.8 and 4.3 per cent of the patients. The total number thus affected amounted to 135, of whom 25 spoke of severe pain and the other 110 of slight to moderate pain. Five had undergone dilatation of the cervix to Hegar 17 and curettage, 113 vaginal hysterotomy, 16 abdominal hysterotomy and sterilization, and one laminaria dilatation, curettage and sterilization. In the great majority the aforementioned painful conditions were not demonstrably due to organic lesions that had resulted from the operations of 1952—53. The only pathologic change that could be attributed with assurance to those operations and had probably given rise to pain, was endometriosis resulting from vaginal hysterotomy, in a small number of cases.

M. URINARY TRACT SYMPTOMS

At the first follow up of the series which was conducted within four years after the operations of 1952—53, six patients claimed to have urinary tract symptoms that had been aggravated, and 32 reported existing or previous urinary tract symptoms that had developed after the operations and were of appreciable intensity or duration. Of the former, one had undergone dilatation of the cervix to Hegar 17 and curettage, and five vaginal hysterotomy; of the latter, one had been subjected to dilatation of the cervix to Hegar 17 and curettage, 30 to vaginal hysterotomy, and one to abdominal hysterotomy and resection of the tubes. Four of the total of 38 had stress incontinence, including one patient with symptoms that had been aggravated after the legal abortion. Each of these four had undergone vaginal hysterotomy in 1952—53. The remaining 34 had pollakiuria, and a few of them dysuria too. Eight of this group, who had undergone vaginal hysterotomy, probably had fairly marked or constant symptoms; in the other 26 the symptoms appeared to have been very mild and, in most cases, temporary. Twenty-two patients who had undergone vaginal hysterotomy in 1952—53 and had pollakiuria with or

without dysuria, were followed up within two years after the operations. — Hysterosalpingography and some form of curettage were performed in 33 cases. Four of the remaining five had had intrauterine pregnancies between the legal abortions and follow up; the fifth, with no further pregnancy, had endometriosis extending to the urinary bladder. Cystoscopic examination was practicable only in a few patients, all of whom had symptoms of appreciable intensity, not attributable to urinary tract infections, when followed up. Furthermore, the incidence and extent of endometriosis were probably underestimated, as pointed out earlier.

Eleven patients with pollakiuria or dysuria were followed up at least once more within four years after the operations. Nine showed, neither then nor earlier, any endometriosis in the hysterotomy scars and had very slight symptoms or none at all; in one who had had endometriosis at a previous follow up, it now involved the urinary bladder; the eleventh patient, who now showed endometriosis in the hysterotomy scar, had become free of symptoms.

Patients with the above-mentioned urinary tract symptoms had not had any postoperative complications directly involving the urinary tract, with the possible exception of one who underwent re-curettage and re-suture. Other signs of disturbances postoperatively or on examination after three weeks had been present in only a few cases.

Neither these nor the other patients exhibited, at the follow up, inflammatory changes in the genital organs that had demonstrably resulted from the operations of 1952—53. A few had undergone operations on the genital organs or had suffered from inflammatory conditions in those organs or in the urinary tract between the legal abortions and follow up; another few patients were suffering from urinary tract infections when followed up.

In an earlier section dealing with symptoms of endometriosis following vaginal hysterotomy, it was mentioned that endometriosis in hysterotomy scars or adjacent parts of the uterus or bladder had probably given rise to the relevant urinary tract symptoms in four cases. Three of these patients had fairly pronounced symptoms that were aggravated in connection with menstruations. One of

them, however, had also undergone a vaginal hysterotomy prior to the one performed in 1952 or 1953, so that it was not possible to ascertain when the endometriosis had arisen. Minor endometriotic changes were observed, it is true, in the hysterotomy scars in three cases, but they scarcely had any bearing on the urinary tract symptoms. One of these three also had endometritis and, possibly, an expansive process in one kidney.

Other organic lesions resulting from the operations of 1952—53 had no demonstrable causal relationship to fairly persistent urinary tract symptoms. True, hysterosalpingography occasionally revealed cavities and fistulae in the isthmic wall, but only in patients with symptoms that later subsided or with endometriosis of the urinary bladder.

Stress incontinence had arisen in three patients, each of whom had undergone vaginal hysterotomy in 1952—53. The intervals between the operations and the onset of symptoms amounted to about six months in two of them and one year in the other. Each of the former two had moderate prolapse of the uterus and vagina; the third had fairly extensive endometriosis in the hysterotomy scar. This latter patient and one of the other two were more or less asymptomatic at subsequent follow ups. In one case stress incontinence was said to have been aggravated after vaginal hysterotomy in 1952 or 1953. This patient, who had pronounced uterine and vaginal prolapse, later claimed to have symptoms that had not appreciably worsened after the legal abortion.

The urinary tract symptoms described above were in most cases mild and in many intermittent, yet they might often have been the initial manifestations of endometriosis involving the urinary tract, according to observations made by Everett (1944), Wharton (1947) and Brosset (1954). In the opinion of the two first-named authors, however, these symptoms may also be produced by other pathologic conditions of the genital organs, or could possibly arise, e.g. in association with menstruations, without being due to detectable lesions. Some of the patients in this series had past or present urinary or genital tract infections, or had undergone surgical measures on the genital organs between the operations of 1952—53 and follow up. In many cases, satis-

factory examination was not practicable. Thus, it was often difficult to decide which factors played, or had played, an etiologic role in the aforementioned urinary tract symptoms.

Many patients with symptoms possibly suggestive of endometriosis involving the urinary tract were examined within two years after vaginal hysterotomy. It was sought to investigate these cases later on as well, since the possibility existed that symptoms due to endometriosis would be aggravated and that endometriotic lesions would be more readily detectable after a longer follow-up period. At subsequent examinations, however, ten patients reported only very slight symptoms or none at all. In nine cases endometriosis was observed neither at the first nor at later follow ups; and here it seemed unlikely that previously reported symptoms had been due to that condition. It was nevertheless conceivable that endometriosis was responsible even for slight symptoms that remained unchanged for long periods or were intermittent; for Novak (1947) pointed out that the development of endometriosis may vary from one case to another.

Two of the three patients with stress incontinence following vaginal hysterotomy also had prolapse, which condition, according to Danielson (1957), is not infrequently associated with the former. Since the prolapse had not demonstrably resulted from the vaginal hysterotomy, there was no proof, either, that the latter had given rise to the stress incontinence. In the third case the symptoms had begun so long after the interruption of pregnancy that a causal relationship scarcely seemed plausible.

The great majority of patients exhibited no such changes, with a probable bearing on the urinary tract symptoms, that had developed since the operations of 1952-53. In some of these cases there had possibly been trauma or mild infections associated with postoperative catheterization of the bladder. Nor, in accordance with observations reported by Bomze (1954), was the possibility precluded that vaginal hysterotomy had caused injuries to the bladder innervation, producing neurogenic vesical disorders.

A total of 38 patients, of whom 35 had undergone vaginal hysterotomy, two dilatation of the cervix to Hegar 17 and curettage, and one abdominal hysterotomy and resection of both

tubes in 1952—53, accordingly reported urinary tract symptoms that had been aggravated or had begun within four years after the operations. Three patients with fairly pronounced symptoms had endometriosis of the bladder wall which in two, or possibly all three, had resulted from vaginal hysterotomy in 1952 or 1953; and one had, as the result of a similar operation, endometriosis in the hysterotomy scar which produced urinary tract symptoms. The others presented symptoms not demonstrably due to such pathologic changes that had been caused by the operations of 1952—53. In the majority these symptoms were mild and intermittent.

N. CASES NOT CLINICALLY EXAMINED

Sixty-six of the 1,188 patients in the series had left Stockholm or had died before the follow up was embarked upon. In these cases no information was available concerning further pregnancies or symptoms referable to the genitourinary tract. Some anamnestic data were obtained in 48 cases, of which 45 had undergone legal abortions alone, and three legal abortion and sterilization in 1952—53. Of the original series there then remained 61 patients, 56 of whom had been subjected to interruption of pregnancy in 1952—53.

Table 57 shows the incidence of intrauterine pregnancies within three years after the operations in the above groups of 45 and 56 cases. There had been no extrauterine pregnancies. In the group of 45, no involuntary sterility with a duration exceeding one year had occurred after the operations.

It will be seen from the table that, after the exclusion of one patient who had radiotherapy for cervical carcinoma, 49 per cent had further pregnancies within three years after the operations. These included seven patients who had shown postoperative temperatures exceeding 38° and four who had cervicitis when examined after three weeks. Bearing in mind the means by which the data were secured, the recorded incidence of further pregnancies within three years may have been lower than the true figure. Hence it hardly seemed probable that the operations of

Table 57. *Occurrence of intrauterine pregnancies after legal abortion, carried out in 1952—53, in cases which were not followed up by gynecologic examination.*

Source of information	Operative method	Total of cases	Number of cases in which pregnancy occurred within 3 years after legal abortion in 1952—53
Case records	Dilatation of cervix and curettage	7	2
	Vaginal hysterotomy	49	21
Patients	Dilatation of cervix and curettage	2	—
	Vaginal hysterotomy	43 ¹	26
Total		101	49

¹ Following the legal abortion, one patient was given radiologic treatment for cervical carcinoma.

1952—53 had caused any severe impairment of fertility in a major number of the cases tabulated above. However, the incidence of involuntary sterility was not known in the group of 56 cases.

The course of the pregnancies occurring after the operations of 1952—53 is detailed in table 58. One full-term delivery and two legal abortions occurred in patients who had undergone dilatation of the cervix and curettage; the remaining pregnancies were in those who had been subjected to vaginal hysterotomy.

Table 58. *Course of pregnancies after legal abortion, carried out in 1952—53, in cases which were not followed up by gynecologic examination.*

Full-term delivery	29
Premature delivery	3
Spontaneous abortion	3
Criminal or infected abortion	2
Legal abortion and, in some, sterilization	28
Course unknown	6
Total	71

Spontaneous abortions and premature deliveries each made up 8.1 per cent of all pregnancies with a known outcome that were not interrupted. All patients with spontaneous abortions or premature deliveries had had at least one full-term pregnancy prior to those interrupted in 1952—53.

Forty-eight patients furnished information on symptoms referable to the genitourinary tract. There were no such symptoms, fresh or aggravated, in two who had undergone dilatation of the cervix and curettage, two subjected to abdominal hysterotomy and resection of both tubes, and one in whom the operation had consisted of supravaginal hysterectomy and bilateral salpingectomy. The remaining 43 had undergone vaginal hysterotomy. In one of them radiotherapy was given for cervical carcinoma following that operation, which had not produced genitourinary tract symptoms. The other 42 are listed in table 59.

Table 59. *Symptoms referable to the genitourinary tract which exacerbated or appeared after vaginal hysterotomy, carried out in 1952—53, in cases not followed up by gynecologic examination.*

Information available; number of cases	Type of symptoms	Exacerbation or appearance of symptoms	
		Number of cases	Intrauterine pregnancy after legal abortion; number of cases
42	Slight to moderate dysmenorrhea	2	2
42	Severe dysmenorrhea	3	2
42	Slight abdominal pain	5	2
30	Slight dyspareunia	5	3
42	Irregular menstruation	2	1
36	Dysuria	2	—
36	Pollakiuria	2	—

N. B. One patient, given radiologic treatment for cervical carcinoma following the legal abortion, was excluded.

It will be seen that relatively intense pain had arisen in three patients with dysmenorrhea, and possibly in two with dysuria. A number with symptoms in the genitourinary tract had further pregnancies after the operations of 1952—53. In these cases there had scarcely been any major functional disturbance in the genital organs. One patient had salpingitis, another endometritis directly following the legal abortion; and four other patients had cervicitis when examined after three weeks. None of these six had had genitourinary tract symptoms later; nor had they been involuntarily sterile.

There was no evidence that the cases described above differed appreciably from the 1,013 clinically examined cases, reported in earlier sections, with respect to the incidence of such disturbances or symptoms that were attributable to the operations of 1952—53.

V. GENERAL SUMMARY

A follow-up investigation was conducted for the purpose of elucidating the incidence and character of somatic complications following legal abortions. The series consisted of 1,188 operations for interruption of pregnancy and, in 144 of them, for sterilization too. In the great majority of cases the durations of the interrupted pregnancies varied between 9 and 24 weeks. Legal abortion alone was performed in most patients — by dilatation of the cervix and curettage in 51 and vaginal hysterotomy in 989; in those who were also sterilized, the operations usually consisted of abdominal hysterotomy and surgery of the tubes (130 cases).

Relatively serious complications directly following the operations were recorded in 3.6 per cent of the total series or in 3.7 per cent of the 983 patients who had undergone vaginal hysterotomy alone without dilatation of the cervix. One patient died of intraperitoneal hemorrhage shortly after operation for interruption of pregnancy and sterilization.

A total of 1,132 patients were examined clinically about three weeks postoperatively, these examinations being performed by

between thirty and forty different gynecologists. Salpingitis was observed in 16, parametritis in four, endometritis in 13, and cervicitis in 78 cases. One patient examined approximately three months after operation was found to have a very small vesico-vaginal fistula. The great majority with the above-mentioned pathologic conditions had undergone vaginal hysterotomy, with uneventful postoperative courses.

One thousand and thirteen were followed up after, as a rule, at least one but not more than five years. Each of these was examined clinically by the author. Hysterograms were taken in 760; endometrial biopsies in 747 cases. In these investigations the following findings were recorded.

Tendency to prolapse (page 43). — No disposition to prolapse was evident as a result of the operations.

Deformation of the portio; fistulae through the anterior cervical wall (pages 44 and 45). — In very few cases vaginal hysterotomy had caused deformation of the portio vaginalis or fistulae through the anterior wall of the cervix.

Cervicitis (page 46). — There was no demonstrably increased incidence of cervicitis following the operations.

Endometriosis (pages 47 and 150). — Endometriosis resulting from vaginal hysterotomy was found in scars in the vaginal wall, and sometimes in adjacent parts of the uterus or urinary bladder, in 19.8 per cent of 840 cases, including seven where it had produced lesions of the urinary bladder. The danger of endometriosis was probably greater than would appear from the above figure, though it could probably have been reduced by consistent use of a suitably adapted technique at vaginal hysterotomy. In the great majority of patients with endometriosis observed within four years after the operations, that condition was unlikely to have produced appreciable symptoms in the genitourinary tract during the period in question. It could not be shown that abdominal hysterotomy had involved any major risk of endometriosis in the abdominal scars.

Pathologic changes in the uterine walls, chiefly in the isthmus and adjacent parts of the corpus, observed at hysterosalpingography (page 72). — Hystero-grams were taken in 614 patients who had undergone vaginal hysterotomy. They revealed, possibly as a result of that operation, a highly irregular contour of the isthmic wall in a few cases, fine fistulae in the anterior isthmic wall in at least 17, and small cavities in the isthmic wall in at least twenty. Fistulae and cavities were also observed on hystero-grams in a small number who had undergone other types of operations. These lesions conceivably pointed to endometriosis. Funnel-shaped recesses, located in the anterior uterine wall in the isthmic region or adjacent part of the corpus and probably due to scars in the uterine wall, were found in 193 cases; they were attributable to vaginal hysterotomy in 143 of 525 patients who had been subjected to that operation once only. Recesses were observed, too, in a few patients who had undergone other types of hysterotomy. There was no evidence that the recesses were due to anatomical changes that had caused an abnormally wide internal os or that had any appreciable obstetrical significance.

Diameter of internal os; incidence of spontaneous abortions and premature deliveries (page 84). — Internal os diameters exceeding 5 mm during the secretory phase were found in 9.2 per cent of 446 cases. The clinical significance of these observations in many cases seemed doubtful, as did the possibility of a causal relationship to the operations. It seemed unlikely that the latter could have given rise, in more than a few cases, to such injuries as to cause internal os insufficiency and hence a disposition to spontaneous abortions or premature deliveries. In the series as a whole no such disposition was demonstrable.

Pathologic changes in the corpus uteri (page 104). — Leaving out of account the above-mentioned recesses in the anterior uterine wall, the operations were not demonstrably associated with any major likelihood of pathologic changes in the corpus uteri.

Pathologic changes in the fallopian tubes (page 110). — In non-sterilized patients there was nothing to suggest that the operations involved any great danger of persistent changes in the tubes. The

incidence of impaired tubal function due to the interruptions of pregnancy probably did not exceed 1.6 per cent, and possibly was substantially lower. Salpingitis or sequelae thereof were found in 15 of 630 patients subjected to hysterosalpingography, but inflammatory lesions that may have been due in their entirety to the operations were present, conceivably, in one case only.

Pathologic changes in the ovaries (page 130). — The operations were not definitely found to have given rise to anatomical changes or functional disorders of the ovaries associated with an increased incidence of anovulatory cycles. One point two per cent of the patients claimed to have had amenorrhea exceeding three months in duration following the operations; 4.1 per cent claimed to have had irregular menstruations, oligomenorrhea or amenorrhea. One patient had amenorrhea lasting more than six months. It often seemed doubtful if the operations had any essential bearing on these disorders. Most of the patients who reported them, otherwise showed no signs of an appreciably disturbed ovarian function.

Fertility (page 142). In non-sterilized patients there seems to have been little risk of persistent impairment of the fertility due to the operations. Only one of 626 patients examined, was considered to have a lasting impairment of the fertility, probably due entirely to the operation. In five patients with impaired fertility or sterility due to bilateral salpingitis or sequelae thereof, it was doubtful if the legal abortions had any causal relationship to those conditions. Altogether, three or four of 626 showed pathologic changes attended by lasting sterility, in one of them probably due entirely to the legal abortion. Involuntary sterility of long duration had been present in five cases, though four of them otherwise showed no signs of impaired fertility at the follow up.

Course of subsequent pregnancies (page 151). — It could not be shown that the operations had caused an increased disposition to complications in connection with subsequent childbirths.

Symptoms referable to the genitourinary tract (pages 152, 156 and 159). — A large number of patients claimed to have had, since

the operations, symptoms that might have pointed to organic or functional disturbances in the genitourinary tract. In the great majority of these cases, however, it seemed doubtful if the operations had any causal relationship to the symptoms. In relatively few of them the symptoms that arose within four years after the operations were possibly due to endometriosis that had resulted from vaginal hysterotomy; in the others it seemed unlikely that the genitourinary tract symptoms had been caused, on any appreciable scale, by persistent lesions attributable to the operations.

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